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Foreword

Inflation creates problems for us all, but it is traditional to point out that it affects those on fixed incomes most of all. For that reason, many public income maintenance programs have incorporated inflation adjustments in recent years. However, the private workers' compensation system has been slow to react, due primarily to the cost impact of indexation of benefits. While the lifetime payments to some workers' compensation cases make the cost of inflation protection very high, they also make the need very great for the beneficiaries.

The idea of a state fund organized to make inflation adjustment payments to workers' compensation beneficiaries was raised before the Michigan Workers' Compensation Reform Task Force in 1979. Since it was put forward as a way to reduce the cost of inflation protection, it seemed worthy of additional study and analysis. This volume represents the outcome of that process. Dr. Hunt has simulated the operation of such a benefit adjustment fund and examined the feasibility of such a program in a world of considerable uncertainty.

Facts and observations presented in this monograph are the sole responsibility of the author. His viewpoints do not necessarily represent positions of the W.E. Upjohn Institute for Employment Research.

Dr. E. Earl Wright
Director

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CHAPTER 1
Introduction

One of the serious shortcomings of workers' compensation as an income maintenance system for the long term disabled is the lack of protection from inflation. The weekly compensation rate in most states is set at two-thirds of the weekly wage as of the time of the injury. There is debate about the adequacy of this ratio, taking into account such factors as the historical maximum at two-thirds of the state average weekly wage, the loss of some or all fringe benefits, the tax free status of workers' compensation benefits, etc. But there is no room for debate on the adequacy of a benefit linked to a wage level 10, 20, or 30 years ago.

During inflationary times like the present, the passage of just a few years with double-digit inflation can have a devastating impact on the standard of living of a disabled worker. This concern is reflected in the following statement by William Marshall, President of the Michigan AFL-CIO, concerning the Michigan workers' compensation system:

> Perhaps the most inequitable part of our present law insofar as benefits is concerned, is the lack of a cost-of-living provision for injured workers. In this age where inflation is a fact of life, our current law fixes benefits as of the date of injury and condemns the disabled to an erosion of their purchasing power and in the final result to welfare.[1]

1. *LABORegister* 3 (June 1979), p. 173.

But it is not just labor interests that have endorsed the principle of inflation adjustment for workers' compensation beneficiaries.

The National Commission on State Workmen's Compensation Laws in 1972 recommended benefit adjustment for permanent total disability and fatality cases:

> We recommend that beneficiaries in permanent total disability cases have their benefits increased through time in the same proportion as increases in the State's average weekly wage.[2]

In May of 1974, a federal interdepartmental study group on workers' compensation published a "White Paper on Workers' Compensation." This report represented the Republican administration's reaction to the recommendations of the National Commission on State Workmen's Compensation Laws. It too endorsed the principle of benefit adjustment:

> *Cost of Living Adjustment.* Beyond the recommendations of the National Commission, we are concerned by the erosion of the value of workers' compensation benefits due to the long-term impact of inflation. Benefits which may have been adequate at the time they were granted, have, over the years, become seriously inadequate.
>
> The States, therefore, should enact an annual cost of living adjustment in benefits paid regularly to employees' survivors and to persons with long-term disabilities. This adjustment should be automatic and compensate for changes in the purchasing power of benefits. On a prospective basis, this should be im-

2. Recommendation 3.14. See also Recommendation 3.22 (fatalities). *The Report of the National Commission on State Workmen's Compensation Laws* (Washington, DC: USGPO), July 1972, p. 64 and p. 71.

plemented immediately. The complexity of retroactive adjustments for those disabled in the past requires further study, including consideration of a gradual phase-in of benefit adjustments.[3]

More recently, the Policy Group of the Federal Interdepartmental Workers' Compensation Task Force, in a follow-up to the White Paper, noted: "An annual cost-of-living adjustment for benefit levels, as recommended in the *White Paper,* is provided in only fifteen states. These vary widely as to the types of benefits adjusted and the formulas used in computing the adjustments."[4] Further, this group added its weight to the now familiar refrain:

> We recommend that long-term wage replacement benefits to disabled workers or survivors be increased annually in proportion to the increase in the State's average weekly wage, and that the pre-injury wage be similarly escalated in all calculations. We urge that State insurance regulatory authorities carefully review and control proposed trend or projection factors in respect to such escalation provisions and that alternative methods of funding increments be explored. This recommendation would apply to all new cases entering the workers' compensation system.
>
> Cases already receiving long-term benefits should also be adjusted to current wage levels. It is difficult to know how the cost of such payments should be allocated, however. States which decide to enact such adjustments, may wish to provide part or all of the funding.[5]

Lastly, on September 10, 1980, the International Association of Industrial Accident Boards and Commissions

3. *White Paper on Workers' Compensation: A Report on the Need for Reform of State Workers' Compensation* (Washington, DC: USGPO), May 1974, pp. 4-5.

4. "Workers' Compensation: Is There a Better Way" (Washington, DC: mimeo), January 19, 1977, p. 21.

5. Ibid., pp. 42-43.

(IAIABC) adopted a new set of standards at their 66th Annual Convention. This represents an attempt by these administrators of workers' compensation programs in the United States and Canada to define the parameters of an ideal workers' compensation system. New *Standard Number Ten* endorses the principle of inflation adjustment:

> (10) BENEFIT ADJUSTMENTS—Compensation payable for total disability or survivor benefits should be adjusted annually to reflect percentage changes in the average weekly wage of the jurisdiction.[6]

Thus there would appear to be widespread agreement that inflation protection for long term workers' compensation beneficiaries is desirable.

While Michigan is one of the states that does provide some inflation adjustment, there is still substantial need for inflation protection. Michigan statute specifies that permanently and totally disabled claimants shall not receive lesser compensation (in weeks or in amounts per week) than is currently provided by law. This amounts to a limited inflation adjustment program, since the benefit is still conditioned by the claimant's wage (so long as the minimum benefit does not come into play). But even this limited adjustment is only paid to those permanently and totally disabled, which is very narrowly defined in Michigan.[7] The result is that a total of less than 1,500 of the roughly 25,000 cases in active payment status were receiving such inflation adjustment payments as of late 1979. This is a start, but it is hardly sufficient to come into compliance with the recommendations recited above.

Since there is little or no disagreement with the premise that inflation protection for some or all long term workers'

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6. Report of the Legislation Committee of the IAIABC, September 8, 1980 (mimeo), p. 7.

7. Under Michigan statute, the totally and permanently disabled are the blind, the incurably insane, double amputees, and those who have lost the industrial use of both arms, both legs or one of each.

compensation beneficiaries would be a good thing, the problem of implementation clearly is the cost. In the words of the IAIABC Legislation Committee report:

> It is understood there are cost implications to this proposal perhaps greater than those which attach to any of the other recommendations we make to the Association. We understand that the legislative response to such recommendations will vary from jurisdiction to jurisdiction. The Committee recommends, and believes the Association will endorse, the explicit statement of principle here that a disabled employee's wage replacement ought to in some manner be assured of retaining its purchasing power. That this might not be an immediately attainable goal should not detract from the fact that *it is a desirable goal.*[8]

When the subject of inflation protection was considered by the Workers' Compensation Reform Task Force in Michigan in August of 1979, the National Council on Compensation Insurance (NCCI) reported that the addition of inflation adjustment would increase benefit costs in Michigan by an estimated 41.6 percent, and this was for a plan with a 6 percent annual cap on the adjustment. Even worse, when inflation adjustment was imposed over the anticipated increase in the maximum benefit to 100 percent of the state average weekly wage, the result would be an estimated 69 percent increase in benefit costs.

It would not be an overstatement to say that these figures shocked some of the Task Force members. Further, it made a compromise reform package difficult, if not impossible, to negotiate. The major business objective was to reduce workers' compensation costs, in the future if not immediately. This translated into specific proposals for coordination of workers' compensation with other income maintenance

8. Report of Legislation Committee, p. 7.

systems, changes in the definition of disability and the statute of limitations, new presumptions on retiree claims and heart or mental disability claims, and others. But if the major labor objectives of increasing the maximum benefit and securing inflation protection for all beneficiaries would raise costs by 69 percent, there was no chance that both sides could secure their objectives.

This paper addresses the issue of the cost of inflation protection from a different perspective. One of the ideas that emerged from the Workers' Compensation Reform Task Force discussions in Michigan was to create a state fund for the purpose of providing inflation protection for workers' compensation beneficiaries. Presumably, the pattern for this suggestion was the current program of differential benefit payments to Michigan's permanently and totally disabled workers' compensation population mentioned above.

The proposal was that insurers would add inflation supplements, in amounts to be specified by the plan, to regular weekly benefit checks as they were distributed through normal channels.[9] Then, at regular intervals (the Second Injury Fund uses six months), the state benefit adjustment fund would reimburse the insurers for the total inflation supplements paid. This plan has the advantage of making maximum use of current administrative machinery, and therefore would entail minimum additional distribution expenses for the workers' compensation system as a whole.

The revenue to make the reimbursement payments could plausibly come from a number of sources, but the specific proposal was that it should be raised by assessment against total indemnity payments by each employer. It could also be raised with some kind of earmarked tax, or even from general revenues, although in neither case would the additional benefit costs be internalized in the production cost of

9. The term insurer refers to both insurance carriers and the self-insured.

the products generating the original injuries—one of the basic principles of the workers' compensation system. The interest earnings of such a state benefit adjustment fund would, of course, not be subject to income taxation. Therefore, a greater proportion of the revenues collected could be translated into benefits for claimants than under a similar benefit adjustment plan in the private sector. This might be particularly significant for a benefit adjustment plan since it will be necessary to accumulate substantial reserves against the lifetime payments that will be required to protect current beneficiaries from future increases in the cost of living.

This paper explores the costs of a state benefit adjustment fund for workers' compensation claimants in Michigan.[10] To facilitate the process, a new methodology was developed. This benefit adjustment model is presented in chapter 2. It grew out of the need to organize the factors in the Michigan workers' compensation system that would impact on the cost of benefit adjustment. It was designed also to utilize the specific data available from the Michigan Bureau of Workers' Disability Compensation, namely, tabulations of active workers' compensation cases by year of injury. Two such tabulations were used to estimate marginal case retention rates and a retention function.

The retention function represents the proportion of cases from a given injury year that will still be drawing weekly income maintenance benefits during each year following the injury year. Thus it describes the persistence of disability cases through time—their retention by the workers' compensation system. Unfortunately, the limited experience (only since 1965) with lifetime benefits for general disability cases in Michigan makes it impossible to observe the tail of the

10. The paper concentrates on prospective benefit adjustment, that is, inflation adjustment for future disability cases. The Appendix demonstrates the application of the methodology developed here to costing retrospective benefit adjustment plans as well.

disability duration distribution. Therefore, the retention function is estimated partly by extrapolation and assumption. This retention function is specific to Michigan, but it should be possible to estimate such a function for any workers' compensation system; thus the methodology should be adaptable to other states.

The model of benefit adjustment is very simple, once the notation is mastered, and it is offered with the expectation that it will prove to be intelligible to policymakers. It is presented not as a finished product, but for further discussion and development. Hopefully, the discussion will lead to improvements that will make the model useful in other applications.

After the development of the conceptual framework for analysis of the benefit adjustment cost problem, chapter 3 presents a simulation of the operation, under stated assumptions, of a benefit adjustment fund for Michigan workers' compensation beneficiaries from the 1978 injury cohort. These results are termed simulations because of the very great level of uncertainty about the number of cases that will be eligible for inflation adjustment payments. This is due primarily to the deficient empirical base for the retention function described earlier. Rather than waiting for years until the actual retention experience is accumulated, it seemed preferable to proceed with a representative, hypothetical retention function and term the results simulations as opposed to projections.

The simulation tracks the fund operation over a 50-year period, representing the expected lifetime of claimants injured in 1978. The simulation results are presented in tables showing the transactions for each year as projected by the benefit adjustment model. This does not imply that it is possible to foresee these events with any clarity, but rather represents an attempt to convey the dynamics of the fund operation in a way that the present value of a 50-year stream of benefit adjustment payments could never do. Nevertheless, it is the present value of this stream, identified in chapter 3 as the forward funding level, which most effectively represents the cost of benefit adjustment.

Chapter 4 probes the sensitivity of this required forward funding level to assumptions about future inflation rates and the number of cases to be adjusted. Since there is no way to accurately forecast these critical parameters, a range of possible values is considered. Then their effect on the required prefunding level of a benefit adjustment fund is determined. In this way, a plausible range for the necessary fund assessment rate is developed despite considerable uncertainty about the future values of the critical parameters.

CHAPTER 2
Methodology

This chapter describes the period analysis model underlying the benefit adjustment simulations to be presented later. It also discusses the estimation of the "retention function," the critical behavioral component of the model. This approach to costing benefit adjustment plans, both prospective and retrospective, is designed to be practical and straightforward in concept and, hopefully, understandable for a nontechnical audience. Some complication is unavoidable when dealing with a dynamic process in a period analysis where individual cohorts must be kept separate, but it should not be an insurmountable obstacle.

Mastery of the model is not required to understand the simulation results, but the impatient reader should not skip the discussion of the retention function. Understanding the way in which the retention function describes the duration of workers' compensation cases is vital both to the evaluation of the method and to the assessment of the simulation results.

This model should also prove to be adaptable to other workers' compensation systems, even though it was developed with Michigan data for Michigan application. It may even be useful for purposes other than costing benefit adjustment programs, although it has not yet been used for any other purpose. The method developed here is designed to make minimal data demands on the workers' compensation system. To adapt this method to other states would simply require estimating the retention function appropriate to the jurisdiction. As developed below, this can be done with as little as two "snapshots" of the active case population one year apart. Of course, the better the description of case durations contained in the retention function, the better the cost estimates the method can produce.

Benefit Adjustment Model

The following represents a model which expresses the relationship between the factors that determine the cost of a benefit adjustment plan. The major complication is in representing the time signatures of variables which are specific to given time periods. In this discussion, two time subscripts will be used. The subscript *i* will always refer to the year of the injury. The subscript *j* will refer to any subsequent year; it is the year counter for the period analysis. This will make it possible to represent present quantities, future quantities, and the relationship between them. While the notation may be somewhat cumbersome, it can be reduced to concepts that have considerable intuitive appeal. Further, with specification of the parameters of a benefit adjustment plan, it will serve as a vehicle for costing such a plan.

Let:

A_i = number of cases from injury year i that receive weekly compensation benefits;

c_{ij} = average weekly compensation rate in year j for cases from injury year i;

d_{ij} = average duration (in weeks) of weekly compensation payments during year j for cases from injury year i;

p_{ij} = proportion of cases from injury year i that are drawing weekly compensation benefits in year j.

Then the number of cases from injury year i that are receiving weekly compensation in subsequent year j is $A_i p_{ij}$, or the product of the number of weekly compensation cases originating in year i and the proportion of these cases that will still be active in year j.[1] Further, the total weekly compensation paid to cases from injury year i in subsequent year j can be represented as:

$$C_{ij} = (A_i p_{ij})\ (c_{ij} d_{ij})$$

The first product is the number of cases from injury year i that will be active in year j and the second is the average total compensation paid in year j to each of these cases. But note that C_{ij} would constitute the base compensation to injury cohort i in year j which would be supplemented by a benefit adjustment plan. Thus, it is one of the major variables determining the cost of such a plan.

Since A_i does not vary with the passage of time, C_{ij} varies with p_{ij}, c_{ij} and d_{ij}. But the average duration of compensation payments in year j to cases from injury year i (d_{ij}) will be basically constant beginning a few years after the injury year. The active case population (those receiving weekly payments) will decline through closures until it reaches the point where it includes only the long term disabled, then the d_{ij} should approach an average duration of 52 weeks in each succeeding year.[2]

1. There is one problem that is concealed by this notation, the fact that at the end of year i all compensable cases with year i injury dates have not yet been identified. This reflects litigation over compensability and late reporting as well as delayed onset of disability. In the empirical simulations to follow, this will be handled by estimating the retention function (p_{ij}) so as to allow for the addition of these cases. Thus, A_i can be treated as invariant with respect to j.

2. Actually, it would never quite reach an average duration of 52 weeks due to the continued closure of cases. If the closures were spread randomly throughout the year, then the average compensation duration during year j for cases that closed during year j would be about 26 weeks. The average duration during year j for the cases that remain active would of course be 52 weeks. The d_{ij} would clearly fall between these subgroup averages, the exact value depending on the proportion of cases that are closed during the year.

Furthermore, in Michigan at least, the average weekly compensation rate (c_{ij}) for a given injury cohort does not appear to vary much with j either. It would not be a surprise if the average weekly compensation rate for cases from a given injury year declined through time as the permanent partial disabilities become relatively more important in the distribution of active cases. This would result from the closure of temporary total disability cases with higher compensation rates. In Michigan, even though there is no distinction made between temporary and permanent disabilities, the process should work similarly. However, the existence of the redemption (compromise and release) possibility in Michigan appears to mitigate this tendency.[3] If most permanent partial disability claims are in fact settled by redemption, it is very likely that these claims would never receive any weekly indemnity payments at all. Thus they do not count in the average weekly compensation rate, and this potential influence on c_{ij} with the passage of time is also negated.

Therefore, the base compensation (C_{ij}) for injury cohort i in year j is revealed to depend primarily on the p_{ij} values, or the proportion of cases remaining in active payment status in future years. The relationship of the proportion of cases from a given injury year remaining active in future years is by far the most critical one in the model. This "retention function" will be examined in some detail later. Suffice it to say at this point that it is the model's representation of the behavior of both claimants and insurers in the workers' compensation system. It is also a major determinant of the costs of benefit adjustment.

This can be seen if we let:

f_{ij} = benefit adjustment factor in year j for cases from injury year i.

3. A compromise and release agreement is referred to as a "redemption of liability" in Michigan. It ends the insurer's liability for the injuries named as emanating from the accident or illness, absent fraud or mutual mistake of fact.

Then the year j cost of supplementing cases from injury year i, according to the benefit adjustment plan that provided the f_{ij}, would be:

$$f_{ij}C_{ij} = f_{ij}(A_i p_{ij})\ (c_{ij} d_{ij})$$

In other words, the annual cost of adjustment would be the product of the adjustment factor and the base compensation paid to injury cohort i in year j, which in turn depends largely on the retention function. While the adjustment factor might be subject to some degree of policy control, at least before the plan was implemented, the retention function will not. Thus the major burden of predicting the cost of a benefit adjustment plan will lie in accurately forecasting the values of C_{ij}, and the retention function which underlies those values.

The actual benefit adjustment factors would depend on the plan adopted, and also on future economic developments. The plan would specify some adjustment mechanism to help maintain the purchasing power of those claimants whose disabilities continue into future years. Presumably, it would be based either on changes in the state average weekly wage or the Consumer Price Index. It might be fully indexed to these changes, or only partially; there might be an annual cap, or perhaps a lifetime cap, on the adjustment factor. There might be a waiting period or some other qualification required before adjustment could begin. These factors would need to be spelled out in any plan adopted. The impact of alternative specification of benefit adjustment plan parameters will be discussed in chapters 4 and 5.

The last development of the adjustment cost model is to sum across the years. All discussion to this point has involved reference to one injury cohort (injury year i) at one point in time (year j). It is possible to sum across i to obtain total benefit adjustment costs in year j for all injury cohorts:

$$S_j = \sum_{i=1}^{j} f_{ij}C_{ij} = \sum_{i=1}^{j} f_{ij}\,(A_ip_{ij})\,(c_{ij}d_{ij})$$

Assuming the plan starts in year $i = 1$, this summation would yield the total cost in year j of adjusting all earlier injury cohorts according to the plan's adjustment factors (f_{ij}) specific to each cohort in year j. In other words, S_j would be the cost in year j of adjusting all existing cases.

Similarly, one could sum across j to get the lifetime benefit adjustment costs (where year v is the last adjustment year) for injury cohort i.

$$S_i = \sum_{j=i}^{v} f_{ij}\,C_{ij} = \sum_{j=i}^{v} f_{ij}\,(A_ip_{ij})\,(c_{ij}d_{ij})$$

In the simulations to be presented later, this is exactly the method that is employed to estimate the lifetime adjustment costs for a single injury cohort with v set at year 50. For each year following the injury year, benefit adjustment costs are calculated as the product of the adjustment factor (f_{ij}) and the base compensation paid to injury cohort i in year j (C_{ij}). This base compensation is in turn the product of the number of cases from injury year i that are still active in year j and the year j compensation paid to the average case from year i.

The quantity S_i represents the future value of payments that must be provided to fully fund a benefit adjustment plan for injury cohort i. The present value of S_i:

$$PV\,(S_i) = \sum_{j=i}^{v} \frac{f_{ij}\,(A_ip_{ij})\,(c_{ij}d_{ij})}{(1+r)^{j-i}}$$

where r represents the rate of discount, is the amount of money that is needed in year i to prefund v-i years of benefit adjustment payments for injury cohort i. If S_i is to be paid from a benefit adjustment fund raised by leveling an assessment against total indemnity payments in year i, the present value of S_i is the amount that must be raised. Thus it represents the solution to the simulation exercises. When expressed as a proportion of total indemnity payments in year i, it will yield the assessment rate.

Before going on to the fund simulation where we will operationalize this model, let us examine in more depth the behavioral content of the model, namely, the retention function.

Retention Function

One of the most critical elements for estimating the cost of benefit adjustment payments in the future is the number of cases that will qualify for adjustment. We have just seen that the future cost of inflation is the product of the adjustment factors and the number of cases that qualify for adjustment. Later we will see how the costs of adjustment vary with both these factors in the sensitivity analysis of chapter 4. In the method employed here, the retention function specifies how many cases will remain "active" from a particular injury cohort at each year in the future. Thus it will provide the number of cases to be adjusted, one of the two critical future quantities determining the cost of benefit adjustment.

But even more interesting in a methodological sense is the fact that the retention function summarizes the operation of the workers' compensation system by tracking the duration of disability cases from a given injury year. In this way, the behavior of claimants, insurers, and even the administrative agency is incorporated into the model. We do not maintain that the simple persistence of disability claims through time is an adequate description of a workers' compensation system for most purposes, but it is clear that it is the most important characteristic for costing an inflation adjustment plan. Unfortunately, the information required to *confidently* predict the number of cases that will qualify for adjustment in future years is not available. First, data on duration of workers' compensation cases are very sparse, and second, it is impossible to make an adequate prediction of behavioral response to an altered system. Thus, even if we had all the data we could hope for on the current system, it would still be necessary to predict the response to a new system.

The data that the Michigan Bureau of Workers' Disability Compensation does have available that can be brought to bear on the problem of estimating the retention function for workers' compensation cases are shown in table 1. This table reports the number of "active" cases, cases receiving weekly income maintenance payments, as of December 31, 1977 and December 31, 1978. With two observations of the active case population one year apart, it is possible to estimate the marginal retention rates at various points on the retention function. In fact, it is possible to estimate each passing year as a separate step on the retention function.

It is important to make clear that "active" status in Michigan is independent of litigation status. The case may have been litigated before entering active status; it may be litigated during or following active status; or, of course, it may never be litigated at all, as is true for the majority of claims. A case is not "active" by the definition used here until and unless weekly indemnity payments have commenced. It is not unusual in Michigan for a case to be compensated and closed without even having been active. This is due to the use of redemption (compromise and release) settlements. If a lump-sum payment is made but no indemnity payments were issued on a weekly basis, the case was never active. This definition is appropriate so long as the benefit adjustment program will confine its attention to cases receiving long term weekly payments only. Even under these circumstances, however, it will be shown that the redeemed cases will have an important bearing on the economics of a benefit adjustment plan, with potential impact on both the cost and revenue dimensions.

The Bureau of Workers' Disability Compensation requires that all cases active as of the end of each calendar year must be reported on Form 103, "Annual Report on Payment of Compensation," by January 31 of the following year. Special tabulations of the December 31, 1977 reports and the December 31, 1978 reports are the data source for table 1. There is some question about the accuracy of these reports, as the Bureau suspects that up to 15 percent of cases active at the end of a typical year may not be reported on Form 103.[4] However, it seems likely that the nonreporting would be concentrated most heavily among recent cases, especially those of short duration which just happened to be in the system on the reporting date.

About one-third of the 24,196 cases reported active at the end of 1978 showed injury dates in calendar year 1978. Probably a much higher proportion of unreported cases would be 1978 origin cases. If this is true, it will introduce a conservative bias into the estimation of marginal retention rates, causing an overestimate of the number of cases to be adjusted in the future. Nevertheless, the point is that there may be an unspecified measurement error present. Using two separate active population measurements and basing the estimates on the comparison between the two will tend to minimize the distortion introduced provided the error is random.

Table 1 shows the active case population by injury year at the end of 1977 and 1978. The last column of the table shows the retention rate that is implied by the change from 1977 to 1978 in the active case population for each injury cohort. The complement of this number would, of course, be the

4. Unfortunately, there has been no investigation of this question for some years due to budget deficiencies at the Bureau of Workers' Disability Compensation.

"closure rate." There is a good deal of variation in the individual year retention rates. This is no doubt due in part to the stochastic element introduced by the measurement error just discussed, but it also reflects the fundamental dynamics of the active case population.

Table 1
Active Case Population, 1977 and 1978, by Injury Year

Injury Year	Cases Active 12/31/77	Cases Active 12/31/78	Implicit Retention Rate
1978	--	7,624	--
1977	6,953	2,805	.403
1976	2,452	2,077	.847
1975	1,979	1,696	.857
1974	1,970	1,830	.929
1973	1,609	1,447	.899
1972	1,380	1,315	.953
1971	1,224	1,182	.966
1970	1,062	1,068	1.006
1969	926	837	.904
1968	678	669	.987
1967	569	550	.967
1966	546	542	.993
1965	204	200	.980

SOURCE: Bureau of Workers' Disability Compensation.

For a given injury cohort, comparing the number of cases active on December 31, 1978 to the number of cases active on December 31, 1977 gives a direct estimate of the retention rate at this point on the retention function. But this will actually slightly overstate the retention rate, since cases can reenter active status after having been closed. For example, between the end of 1977 and the end of 1978 the number of *active* cases with date of injury in 1974 declined from 1,970 to 1,830. Dividing 1,830 by 1,970 indicates a retention rate of

.929. But this assumes that only the 1,970 cases from 1974 active as of December 31, 1977 could potentially have been active one year later. In fact, the 1,830 active cases from the 1974 injury cohort as of December 31, 1978 no doubt include some cases that were *not* active one year earlier. The case may have been closed previously but weekly payments were resumed during 1978, or it may be that the disability resulting from a 1974 injury has only recently emerged and a new claim has just been entered.

One or both of these factors presumably accounts for the fact that the 1970 injury cohort is reported to have grown between the end of 1977 and 1978. Table 1 shows that there were 1,062 injury cases from 1970 active at the end of 1977, but 1,068 active one year later. This could reflect an influx of cases with 1970 injury dates that is greater than the number of 1970 cases closed during the year. It could also reflect measurement error that resulted in undercounting the 1970 cohort in 1977. With all these qualifications and reservations in mind, let us proceed to use the data of table 1 to estimate the retention function for workers' compensation cases in Michigan.

From the 1977 injury year cohort, there were 6,953 cases active at the end of 1977, but only 2,805 active at the end of 1978. Thus nearly 60 percent (net) of the 1977 cases had closed during 1978; 40 percent were retained by the system. The problem is that these numbers are somewhat difficult to interpret. Note that among the 6,953 cases from 1977 active at the end of 1977 there will be a complex mixture of durations of disability. Specific dates of injury could range from January 1, 1977 to December 23, 1977 (due to the one-week waiting period). Expected future duration of disability presumably would vary from one day to a lifetime.

Notice also that included among these 6,953 cases will be what are typically known as temporary partial, temporary total, permanent partial, and permanent total disabilities, as well as fatality cases. While this approach may seem peculiar to some, Michigan law does not distinguish between temporary and permanent disabilities (except for a restrictive statutory definition of total and permanent disability). Thus representing disability claims only through their durations is not so strange in Michigan. In fact, it sometimes seems artificial to try to fit Michigan cases into the conventional disability categories.

It follows from the mixture of cases active at any point in time that there can be a number of reasons why a case might close. First, the claimant may recover and return to work. Second, the statutory term of benefits may elapse (for a scheduled loss or a fatality). Third, the case may be closed through a redemption settlement (although most redemptions are not on a weekly payment at the time of settlement). Fourth, in the case of a partial disability, the claimant's earnings in his or her alternative employment may rise to equal the previous earnings, thus "eliminating" the wage loss that occasions the weekly compensation payments. Fifth, the claimant may die from causes other than the work-related injury or disease that produced the disability.[5] Clearly, the incidence of each of these and the balance among them are related to the elapsed time since the date of the injury.

Whatever the reasons, it appears that 60 percent of the 1977 injury cases that were active at the end of 1977 were closed by the end of 1978. Thus the estimated net marginal retention rate is .40 between the end of the injury year and the end of the following year; this is the first step in the estimated retention function. To derive the second step it is necessary to address the 1976 injury cohort. At the end of

5. This list is not meant to be exhaustive. Obviously, there are a great many other reasons which might bring weekly payments to a conclusion. But these would seem to cover the major possibilities.

1977 there were 2,452 cases from 1976 in active status. One year later there were 2,077; thus, 15 percent were closed, 85 percent retained. The second marginal step on the estimated retention function is .85. We can thus proceed to estimate the net marginal retention rate for each year subsequent to the injury year. Then we can use this chronological step function to represent the persistence of disability cases from any injury cohort into the future.

Assuming the 1976 injury cohort experience is representative, it is predicted that 85 percent of the 2,805 cases from 1977 active at the end of 1978 will still be active at the end of 1979. Further, it is predicted that 2,592 injury cases from 1978 will be active at the end of 1980 (7,624 x .40 x .85). The data in table 1 enable one to estimate marginal retention rates back 13 years to the 1965 injury cohort, the first one eligible for lifetime benefits regardless of disability level.

While this is rather sketchy evidence upon which to build the central element of the inflation adjustment fund simulation, it is also the best information available at the present time. Of course it would be desirable to have more observations to minimize the impact of reporting errors and other random events. Both earlier cohorts and additional snapshots would be helpful in increasing confidence that the retention function adequately represents the case dynamics. Nevertheless, from the data in table 1 and some heroic assumptions, one can construct a hypothetical retention function to represent the persistence, or retention, of cases through the 50 years following the injury.

During the first year following the injury year, 40 percent of cases active at the end of the injury year are retained. During each of the next two years, 85 percent of the cases active at the beginning of the year are retained. During the fourth and fifth years following the injury, 92 percent are retained. Thereafter, 96 percent of cases active at the beginning of the year are retained through the end of the year. Twenty years after the injury year, it is hypothesized that the retention rate declines again to 92 percent as old age begins to overtake a larger portion of the injured workers.[6]

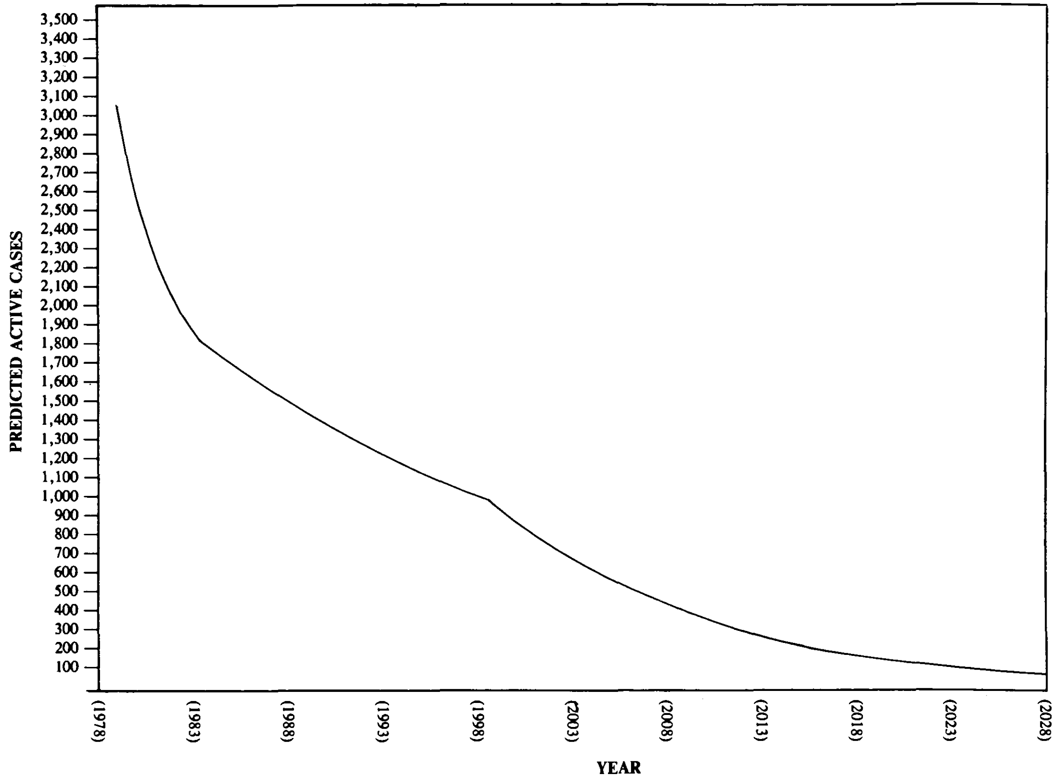
Figure 1 shows the result of applying this hypothetical retention function to the 1978 injury cohort and projecting the number of 1978 cases that will be active at the end of each of the next 50 years. Since the retention function is derived from current experience for the first decade following the injury, it is impossible to know how accurate it will be. In fact, it should be regarded as hypothetical rather than possessing any definitive behavioral content. It is a tool to help simulate the way the system is currently operating, not a separate prediction of the future. In particular, it does not predict any change in behavior as a result of the imposition of benefit adjustment payments or any other change in the workers' compensation system.

Table 2 shows that 80 percent of the 1978 year-end active cases will have closed by the end of 1988, 90 percent by the end of 2002. But these figures represent the relationship to the number of 1978 injury cases still active on December 31, 1978, not the entire 1978 injury cohort. In fact, the Bureau of Workers' Disability Compensation reported 68,516 workers' compensation claims voluntarily paid (i.e., not contested) in 1978. So only about one case in nine from the 1978 cohort was actually open at the end of 1978. Thus, the 1,521 active cases from the 1978 cohort predicted for 1988 would constitute about 2.2 percent of the original cohort.[7] The prediction of the retention function, therefore, is that

6. For the male population, the death rate at age 65 is about 4 percent per year. It could be anticipated that this would significantly understate the death rate among those who had been disabled for 20 years. In addition, there would still be closures from other causes as well.

7. It is very difficult to get more accurate measurements of particular injury cohorts because the Bureau does not keep separate track of the injury year, but simply counts the number of cases processed in the calendar year.

Figure 1
Predicted Active Cases (as of end of calendar year)



just over 2 percent of the 1978 injury cases will be active 10 years later. After 20 years all but about 1.5 percent, and after 30 years all but about 0.6 percent of the 1978 cohort will be closed.

Table 2
Predicted Active Cases from 1978 Injury Cohort

End of Year	Predicted Active Cases	End of Year	Predicted Active Cases
1978	7,624	2004	613
1979	3,050	2005	564
1980	2,592	2006	519
1981	2,203	2007	477
1982	2,027	2008	439
1983	1,865	2009	404
1984	1,790	2010	372
1985	1,719	2011	342
1986	1,650	2012	315
1987	1,584	2013	289
1988	1,521	2014	266
1989	1,460	2015	245
1990	1,401	2016	225
1991	1,345	2017	207
1992	1,292	2018	191
1993	1,240	2019	175
1994	1,190	2020	161
1995	1,143	2021	149
1996	1,097	2022	137
1997	1,053	2023	126
1998	1,011	2024	116
1999	930	2025	106
2000	856	2026	98
2001	787	2027	90
2002	724	2028	83
2003	666		

As one very rough test of the representativeness of this retention function, we can reverse the procedure used in its construction. Instead of looking at the number of active cases at one point in time, we could try to predict the number of cases that would be active using the retention function and what information is available on the number of cases originating in each past year. Then we can compare the predicted number of active cases at a point in time with one of the actual measurements of active cases.

Table 3 presents the results of just such an exercise. Beginning with the proportion that active cases at the end of 1978 were to cases voluntarily paid in 1978 (7,624 to 68,516 or .1113), this proportion is then reduced step by step in accordance with the retention function developed earlier. This estimated net retention rate is shown in the third column of table 3. It is then multiplied by the number of cases voluntarily paid in each year back to 1969 to arrive at the predicted number of cases active at the end of 1978.[8]

It is not strictly correct that only voluntarily paid cases would be potential future actives, of course. There would be some litigated cases from each injury year that would enter active payment status at a later date. However, data are not available on these cases, so the voluntary payment cases were used as the base. This creates no distortion since the estimation of the retention function originally utilized all active cases regardless of origin, thus the effect of "new" cases from previous injury years is already included in the retention function.

Generally speaking, the retention function appears to predict the active case population fairly well. The last column of table 3 indicates that the ratio of predicted active

8. Data are not available on the same reporting basis before 1969. In any event, data before September 1965 would not be relevant since this was when limitation of benefits was lifted for general disability cases.

cases to measured active cases varies about unity with no discernible trend, at least in the early years. The upward swing in 1970 and 1969 in the ratio of predicted to actual may indicate that the retention function is not "closing" cases as rapidly as in actual practice. It is difficult to tell without data for earlier years, but this could mean that we are significantly overestimating the number of active cases as we approach the long run. This would have the effect of making prospective benefit adjustment plans appear to be more expensive than they truly are.

Table 3
Comparison of Predicted with Actual Cases Active

Injury Year	Voluntary Cases Paid[a]	Estimated Net Retention Rate	Predicted Cases Active 12/31/78	Actual Cases Active 12/31/78[a]	Ratio Predicted/ Actual
1977	66,861	.044	2,975	2,805	1.06
1976	56,234	.038	2,126	2,077	1.02
1975	50,905	.032	1,639	1,696	.97
1974	58,005	.030	1,717	1,830	.94
1973	55,528	.027	1,510	1,447	1.04
1972	49,578	.026	1,294	1,315	.98
1971	45,808	.025	1,150	1,182	.97
1970	47,647	.024	1,148	1,068	1.07
1969	44,573	.023	1,030	837	1.23

a. Figures provided by the Bureau of Workers' Disability Compensation.

This retention function predicts 15.2 years average duration of disability payments for cases that are still active two years after injury, i.e., that become eligible for adjustment payments in the plans with a two-year waiting period to be presented later. But the inverse of the duration would be the average annual closure probability. If the case population is characterized by an average duration of 15.2 years, then one would expect about 6.6 percent (1/15.2 = .0658) of the case population to close each year.

This assumes that the active case population from each injury cohort declines regularly through time, i.e., the retention function is a "well-behaved" function. But if the closure rate is 6.6 percent, the average retention rate would be 93.4 percent. So among cases that will show at least two years of disability payments, the year-to-year retention rate characterizing the population as a whole would be about 93 percent.

While it is not perfectly compatible, this figure can be compared to the experience of the Second Injury Fund in Michigan with the statutory permanent and total disability claimant population.[9] Michigan statute provides:

> Any permanently and totally disabled person as defined in this act, . . . who, on and after June 25, 1955, is entitled to receive payments of workmen's compensation in amounts per week of less than is presently provided in the workmen's compensation schedule of benefits for permanent and total disability, and for a lesser number of weeks than the duration of such permanent and total disability, . . . shall receive weekly from the carrier on behalf of the second injury fund dif-

9. There is a restricted use of the term permanent total disability in Michigan which should be distinguished from ordinary usage. The statute provides the following definition (Section 361(2)):

Total and permanent disability, compensation for which is provided in section 351 means:

(a) Total and permanent loss of sight of both eyes.

(b) Loss of both legs or both feet at or above the ankle.

(c) Loss of both arms or both hands at or above the wrist.

(d) Loss of any 2 of the members or faculties enumerated in (a), (b) or (c).

(e) Permanent and complete paralysis of both legs or both arms or of 1 leg and 1 arm.

(f) Incurable insanity or imbecility.

(g) Permanent and total loss of industrial use of both legs or both hands or both arms or 1 leg and 1 arm.

> ferential benefits equal to the difference between what he is now or shall hereafter be entitled to receive from his employer under the provisions of this act as the same was in effect at the time of his injury, and the amounts now provided for his permanent and total disability by this or any other amendatory act, with appropriate application of the provisions of sections 351 to 359. (Section 521(2))

Since maximum and minimum rates are adjusted automatically every year to reflect changes in the state average weekly wage, this amounts to a benefit adjustment plan for a subset of the permanent and total disability cases.[10]

By comparing the number of permanent total disability cases being paid differential benefits at the end of each year with the equivalent number from last year plus the number of new cases acquired during the year, it is possible to measure the number of terminations during the year. Then the gross retention rate is simply one minus the termination rate. Table 4 presents these calculations for the differential benefit cases in Michigan. There is some variation in this case population with court decisions from time to time, which introduces a certain amount of "noise" into the data. But table 4 indicates annual gross retention rates for the permanent and total disability population varying from .87 to .98. The average gross retention rate for the years shown in table 4 is .93.

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10. It is a subset because not every permanent and total disability case receives differential benefits. Suppose a claimant is receiving the maximum compensation rate, and therefore is receiving less than two-thirds of gross earnings. As the maximums rise, this individual's benefit will rise also, until the two-thirds replacement level is reached. Then the benefit will stop escalating because it reaches the compensation rate due under current law, with *previous* earnings. This claimant will not experience any further adjustment until the compensation rate is overtaken by the minimums.

Table 4
Second Injury Fund Experience

Year	Permanent Total Disability Case Population: Cases being Paid at End of Year	Permanent Total Disability Case Population: New Cases Acquired	Implicit Terminations[a]	Implicit Retention Rate[b]
Fiscal				
1968-69	273	--	--	.963
1969-70	318	55	10	.946
1970-71	379	78	17	.900
1971-72	458	107	28	.904
1972-73	523	109	44	.920
1973-74	606	125	42	.978
1974-75	758	165	13	.872
Calendar				
1975	831	170	97	.939
1976	957	177	51	.973
1977	1,124	193	26	.939
1978	1,248	193	69	--

SOURCE: Funds Administration Annual Report, *LABORegister* (June 1979), pp. 164-168.

a. Implicit terminations for year t are calculated by adding cases being paid at the end of year t-1 to acquisitions during year t and subtracting cases being paid at the end of year t.

b. Implicit retention rate is implicit terminations in year t as a proportion of cases being paid at the end of year t-1.

It would be unwise to make too much of the identity of this figure with that derived from the hypothetical retention function developed earlier. It is not possible to specify exactly how the population of cases active for more than two years would relate to the permanent and total disability population, much less a subset of that population. But clearly, the former would be inclusive of the latter. Further, if the permanent and total disability cases are expected to be the longest duration of any disability category, the probability of their closure should be lowest. Thus a procedure which estimates the closure probability of the general case population with more than two years' disability as similar to the actual closure experience of the permanent and total disability population would seem to be rather conservative. In addition, it is difficult to avoid noticing that there are only about 200 new permanent and total disability cases certified each year, while the retention function predictions of table 2 showed 10 times that number of active cases 5 years after the injury year.

In the absence of better information, we will use the retention function derived here to represent the persistence of the disability population in Michigan. It seems likely that it shows many more long duration cases than will actually be experienced, but perhaps that is just as well. Conservative estimation of the retention function is an important safeguard that may turn out to have anticipated the behavioral response to the introduction of benefit adjustment.

With this description of the underlying relationships in place, and bearing in mind the limitations of the data base with which we are working, let us proceed to examine the operation of a benefit adjustment fund for workers' compensation beneficiaries in Michigan.

CHAPTER 3
Simulated Benefit Adjustment Fund Operation

In this chapter we will first discuss the basis for adjustment of workers' compensation benefits. Alternative goals of maintaining purchasing power, maintaining relative standards of living, or maintaining alternative earnings levels will be considered. Then the simulated operation of a benefit adjustment fund charged with adjusting benefits for one workers' compensation injury cohort over a 50-year period will be examined in some detail. This analysis will yield an estimated forward funding level required to prefund lifetime benefit adjustment payments for one injury cohort. A discussion of the consequences of overfunding or underfunding such a plan and a brief evaluation of the cost estimate will follow the presentation of the single cohort simulation results. After a full exposition of single cohort results, the operation of the full fund, responsible for adjustment of all injury cohorts, is considered.

Basis for Adjustment

Before turning to the simulated operation of a benefit adjustment fund, a short discussion of the basis for adjustment is in order. The most important question is simply, "What are we trying to do?" There are at least three conceptions of the goal of benefit adjustment.[1] The simplest objective (and least expensive under historical conditions) is to maintain the purchasing power of the workers' compensation benefit received by the disabled worker. Putting aside the question of whether the weekly income maintenance benefit is adequate to begin with, we could at least endeavor to keep it constant in real terms, to prevent any inflation induced degradation in the injured worker's economic situation. There is some dispute as to how adequately the present U.S. Bureau of Labor Statistics "market basket" approach to measuring changes in the cost of living represents the actual price changes as they affect particular individuals, especially the retired or disabled. But the principle of benefit adjustment according to a price index is well understood and should present no special problems of implementation. Thus, if the goal of benefit adjustment is to protect the purchasing power of the workers' compensation benefit, we could simply index it to the Consumer Price Index (CPI).

On the other hand, the objective of benefit adjustment may be to maintain parity of living standards between the injured worker and his or her more fortunate nondisabled colleagues. This would imply the use of a wage index to adjust workers' compensation income maintenance benefits. Under "normal" circumstances, wages tend to rise more rapidly than prices, on the average, thus providing a rising real standard of living. Under such circumstances, many have argued that it is unfair to deny the disabled worker an opportunity to share in these gains.

In the face of a generally improving standard of living, the individual or family held to the same absolute consumption levels by a price index adjustment will experience a sense of loss relative to their more fortunate friends and neighbors. It

1. See Robert J. Myers, *Indexation of Pension and Other Benefits* (Homewood, IL: Irwin, 1978), Ch. III for a more thorough discussion of indexation options and their implications.

might also be pointed out that this loss would be imposed on top of the original loss occasioned by the fractional wage replacement paid in workers' compensation (usually two-thirds, less for a high wage worker). Yet, in the past few years, prices have tended to rise more rapidly than wages, providing the average worker with a declining standard of living. Under these circumstances, a disabled worker whose compensation was indexed to the CPI would do better than his working colleagues.

The third possible objective for benefit adjustment would be to attempt to replace the disabled worker's alternative earnings—what would have been received had he or she not been injured. This plan would have to take account of the injured individual's occupation, age, education and other circumstances and then predict what earnings would have been achieved in the absence of the injury in order to measure the wage loss. While this approach is the most hypothetical, it could possibly be implemented with adequate age-earnings profiles for different groups. It is probably an open question whether this would create more equity issues than it would resolve, however.

There are other possible approaches of course, but these would seem to be the leading contenders for a benefit adjustment scheme. Realistically, given the complexities of the alternative earnings approach, the choice comes down to a price index or a wage index as the basis for benefit adjustment. Table 5 shows the trends in the Michigan state average weekly wage (SAWW) and the Detroit CPI since 1950.[2] While the past is not necessarily a reliable guide to the future, these figures do show the familiar pattern of annual wage increases in excess of price increases except in highly inflationary or recessionary times.

2. Actually, the Detroit CPI is not available before 1960, so the changes in the U.S. CPI were spliced into the Detroit series to reach back to 1950.

Table 5
Inflation Adjustment Factors

Year	SAWW	Annual Change (percent)	Detroit CPI	Annual Change (percent)
1978	$275.41	8.1	194.1	7.6
1977	254.79	9.6	180.4	6.9
1976	232.39	8.4	168.8	5.4
1975	214.38	5.4	160.1	7.4
1974	203.34	4.6	149.0	10.8
1973	194.34	6.4	134.5	6.6
1972	182.63	8.2	126.2	3.7
1971	168.86	5.1	121.7	3.7
1970	160.68	3.8	117.4	6.1
1969	154.81	6.7	110.6	6.0
1968	145.11	5.6	104.3	4.3
1967	137.41	2.3	100.0	3.4
1966	134.38	3.3	96.7	4.4
1965	130.07	4.3	92.6	2.3
1964	124.74	5.2	90.5	0.8
1963	118.55	4.5	89.8	0.7
1962	113.43	3.6	88.9	0.2
1961	109.47	0.6	88.7	0.6
1960	108.86	1.7	88.2	1.0
1959	106.99	6.0	87.3	0.8
1958	100.93	1.7	86.6	2.7
1957	99.26	2.1	84.3	3.6
1956	97.24	1.7	81.4	1.5
1955	95.62	6.1	80.2	-0.4
1954	90.12	1.0	80.5	0.5
1953	89.24	7.1	80.1	0.8
1952	83.33	7.5	79.5	2.2
1951	77.50	7.8	77.8	7.9
1950	71.90	--	72.1	--

SOURCES: Michigan Bureau of Workers' Disability Compensation (SAWW) and *Michigan Statistical Abstract,* 14th Edition, 1979 (CPI).

Over the period of 28 years, the annual compound rate of increase in the state average weekly wage was 4.9 percent; for the Detroit CPI, 3.6 percent. For the decade from 1968 to 1978, however, the SAWW increased by 6.6 percent per year while the Detroit CPI increased at 6.4 percent annually. If we have entered an era marked by no significant growth in real earnings as some have suggested, it makes little difference whether we choose to adjust benefits by a price index or a wage index since the gap between the disabled and nondisabled will not widen through time anyway.

On the other hand, if we return to more normal conditions (by historical standards), then the decision on the basis for benefit adjustment may turn out to be quite important. We shall see in chapter 4 that the magnitude of the annual benefit adjustment factor is a critical determinant of the cost of a benefit adjustment program.

Clearly, a political judgment will have to be made between a wage or price index before a benefit adjustment program can be implemented. For the purposes of the simulated fund operation to be presented here, however, we can ignore the technical basis for adjustment and simply work with an assumed annual adjustment factor. The standard simulation assumes a 5 percent annual adjustment factor, although the sensitivity analysis in chapter 4 examines a range of 4 to 8 percent. The 5 percent plan is treated as the standard of comparison throughout the paper, however, and it is discussed in considerably more detail. While a 5 percent inflation factor sounds low at the present time, it is not unrealistic by historical standards. Let us proceed then to examine the simulated operation of a benefit adjustment fund for workers' compensation claimants in Michigan.

Single Cohort Fund Operation

Given the discussions in Michigan to date, it seems likely that a benefit adjustment fund would operate much the way the Second Injury Fund does currently. There would be an assessment made against the indemnity payments in the injury year, or base year, with the assessment rate specified by statute or administratively determined by the Bureau. It is assumed here that all benefit adjustment costs are to be forward funded, that is, a sufficient amount of money is to be collected through the assessment to fund lifetime benefits for all disability cases originating in the base year.[3] Thus, if the case duration relationships represented by the retention function remain stable through time, a constant assessment rate applied to each year's indemnity payments would fund each injury cohort's future benefit adjustment payments. For this reason we can confine our attention to a single cohort without loss of generality.

Each insurer would probably pay the same assessment rate on his base year indemnity. It would be possible to introduce experience rating, although this might prove difficult to implement. Under an experience rating system it would be necessary to differentiate between employers on the basis of the proportion of their workers' compensation benefit costs that flow to long term as opposed to short term disability cases. Thus an employer who experienced no long term disabilities, and hence no claims against the benefit adjustment fund, might have his or her assessment rate reduced. One with many claims against the fund could be assessed at a higher rate. There would be a serious complication introduced by the redemption possibility in Michigan, however. This problem will be outlined later in the chapter.

It is assumed that the funds from the assessment would be received on July 1 of the year following the base year. This reflects current Second Injury Fund practice and should allow sufficient time for administrative detail. The funds would then be invested (perhaps in a way that would improve economic conditions in the state) and interest earnings would begin. For the purpose of the simulation, a return of 7 percent is applied against the average balance for each year.

3. Alternatively, it would be possible to structure a benefit adjustment fund as a "pay-as-you-go" operation. However, fear of the "blank check" element inherent in the unfunded liabilities of such a plan militates against it. See chapter 5 for a discussion of this and other alternative fund formulations.

This seems low at the present time, but recall that these projections cover a 50-year time span. It would seem preferable to err on the side of caution. Alternative assumptions will be presented in chapter 4, Sensitivity Analysis.

The average annual balance of the benefit adjustment fund would naturally be influenced by the timing of disbursements as well. As with the Second Injury Fund, it is assumed that insurers will be given responsibility for making benefit adjustment payments as supplements to the regular weekly payments, with reimbursement from the fund at six-month intervals. Adjustment payments would commence on the anniversary of the injury, subject to a two-year waiting period. Under this plan, administrative expenses, both for the insurer and the fund, would be kept to a minimum. In the simulation, an allowance of 8 percent of disbursements has been made for administrative expenses of the fund. This is less than the Second Injury Fund experiences currently, but it is anticipated that this program will be simpler and also subject to less litigation than current Second Injury Fund operations.

For purposes of illustration, it may be useful to trace through step by step the first few years of operation of such a fund. Table 6 presents the results of one such simulation based on the 1978 injury cohort, the latest one for which data are available.[4] An assessment would be levied against the indemnity paid by each insurer in 1978, a total for all insurers of $334,784,000. Let us assume the assessment rate is set at 24.7 percent. Of course, this is not really an assumption, but

4. The simulations of the benefit adjustment fund operation to be presented here focus only on the 1978 injury cohort. The actual operation of such a fund may or may not allow commingling of the assessments from different base years, but the description of the fund's operation is simplified if we confine our attention to a single cohort. It should be clear that the choice of any particular injury year for the simulation, while it would change the absolute dollar amount needed to finance future benefits, should not change the relative amount, that is, the assessment rate.

Table 6
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,894,500	$ 85,584,500
1980	2,822	.0247	502,918	5,982,110	91,033,458
1981	2,399	.0759	1,314,373	6,347,500	95,961,436
1982	2,039	.1297	1,908,768	6,681,225	100,581,191
1983	1,876	.1862	2,520,705	6,993,042	104,851,871
1984	1,726	.2455	3,057,690	7,281,841	108,831,407
1985	1,657	.3078	3,679,932	7,548,648	112,405,728
1986	1,590	.3732	4,283,241	7,787,448	115,567,275
1987	1,527	.4418	4,868,422	7,997,696	118,307,076
1988	1,466	.5139	5,436,247	8,178,750	120,614,679
1989	1,407	.5896	5,987,460	8,329,865	122,478,086
1990	1,351	.6691	6,522,774	8,450,186	123,883,676
1991	1,297	.7526	7,042,874	8,538,747	124,816,119
1992	1,245	.8402	7,548,418	8,594,463	125,258,291
1993	1,195	.9322	8,040,038	8,616,124	125,191,173
1994	1,147	1.0288	8,518,342	8,602,385	124,593,749
1995	1,101	1.1303	8,983,913	8,551,766	123,442,890
1996	1,057	1.2368	9,437,311	8,462,637	121,713,230
1997	1,015	1.3486	9,879,076	8,333,212	119,377,040
1998	934	1.4661	9,880,152	8,169,658	116,876,133
1999	859	1.5894	9,854,235	7,995,084	114,228,644
2000	790	1.7188	9,804,398	7,810,702	111,450,596
2001	727	1.8548	9,733,439	7,617,580	108,556,062
2002	669	1.9975	9,643,901	7,416,655	105,557,303
2003	615	2.1474	9,538,096	7,208,741	102,464,901
2004	566	2.3047	9,418,121	6,994,541	99,287,871
2005	521	2.4700	9,285,880	6,774,648	96,033,769
2006	479	2.6435	9,143,096	6,549,559	92,708,784
2007	441	2.8257	8,991,333	6,319,679	89,317,823
2008	406	3.0169	8,832,001	6,085,323	85,864,585
2009	373	3.2178	8,666,377	5,846,726	82,351,624
2010	343	3.4287	8,495,611	5,604,047	78,780,411
2011	316	3.6501	8,320,739	5,357,367	75,151,379
2012	291	3.8826	8,142,695	5,106,700	71,463,968
2013	267	4.1267	7,962,316	4,851,990	67,716,657
2014	246	4.3831	7,780,351	4,593,117	63,906,995
2015	226	4.6522	7,597,474	4,329,897	60,031,621
2016	208	4.9348	7,414,281	4,062,084	56,086,281
2017	192	5.2316	7,231,308	3,789,368	52,065,836
2018	176	5.5432	7,049,026	3,511,382	47,964,270
2019	162	5.8703	6,867,856	3,227,696	43,774,683
2020	149	6.2138	6,688,165	2,937,821	39,489,286
2021	137	6.5745	6,510,279	2,641,206	35,099,390
2022	126	6.9533	6,334,480	2,337,236	30,595,387
2023	116	7.3509	6,161,014	2,025,234	25,966,726
2024	107	7.7685	5,990,093	1,704,458	21,201,884
2025	98	8.2069	5,821,900	1,374,098	16,288,330
2026	90	8.6672	5,656,587	1,033,274	11,212,489
2027	83	9.1506	5,494,285	681,032	5,959,694
2028	77	9.6581	5,335,099	316,345	514,133

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 5 percent compound
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$82,700,000**

represents the "solution" of the simulation problem. It is the amount required to prefund the 50 years of benefit adjustment payments directed by the plan.[5] As will be discussed below, this figure does not include any potential savings from Second Injury Fund differential benefit payments, disqualification of some cases due to changes in the definition of disability or other statutory changes, or coordination of benefits with other income maintenance programs.

The $82,700,000 yield from this assessment would be received on July 1, 1979 and would immediately be invested and begin earning interest at 7 percent per year. But it is only invested for half of 1979, so interest earnings for the year would be only $2,894,500. Table 6 assumes there is a two-year waiting period before benefit adjustment begins, so no supplements are paid during 1979 for 1978 injuries. Accordingly, no administrative costs are charged. At the end of 1979, the benefit adjustment fund would show a balance of approximately $85,594,500.[6]

From the discussion earlier of the retention function, it will be recalled that there were 7,624 cases from 1978 active at the end of 1978. Further, the retention function predicts that 3,050 cases from 1978 injuries will be active at the end of 1979. So, as we enter calendar year 1980, there would be just

5. Fifty years was chosen as the practical expression of "lifetime benefits" for one injury cohort. The fact that the simulation shows payments to 77 individuals in the 50th year of operation should be taken as indicative of the conservatism of the retention function. It should also be pointed out that the fund ends the 50-year period with a balance of over $500,000. This is a consequence of the method used to derive the assessment amount in the first place. An iterative technique was employed that essentially proceeds by trial and error. A specific assessment amount is picked to start the problem and the amount is reduced in $100,000 steps until the fund goes broke before year 51. The last iteration, $100,000 higher than the amount that went broke, is the solution. Because of the compound interest interactions in this problem, $100,000 at the start makes a surprising impact over the life of the fund.

6. Of course none of these figures should be taken as precise estimates. Given the nature of the assumptions, all numbers used in the simulations should be taken as indicative of a general range even when they are reported more precisely.

over 3,000 workers' compensation cases from 1978 drawing weekly benefits. As these cases reach their second injury anniversary date in 1980, they would become eligible for inflation supplements. Of course, not all 3,050 cases will become eligible on January 1; they will be spread more or less evenly over the calendar year, as were the original injuries.

The "average" case would become eligible for adjustment at mid-year, on July 1. Thus, the "average" case would receive one-half of the plan's 5 percent adjustment supplement due in 1980.[7] Injuries that occurred on January 1, 1978 would receive the 5 percent supplement during all of 1980, but injuries that occurred on December 31, 1978 would receive no benefit adjustment payments during 1980. The average adjustment payment would be 5 percent for half the year (or 2.5 percent for a full year). The actual dollar amount of the average benefit adjustment during 1980 can then be calculated as the product of the average weekly compensation rate for 1978 injuries (reported by the Bureau as $138.78), times 26 weeks (half the year), times the adjustment factor (5 percent), or $180.41. This amounts to 2.5 percent of the typical annual compensation payment of $7,216.56 for 1978 injuries. Thus, the third column of table 6 shows 2.47 percent as the average adjustment factor paid during 1980.[8]

But this average adjustment factor will likewise not be paid to all 3,050 cases active at the beginning of 1980 but rather to the "average" number of cases active during 1980.

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7. In the simulations presented here, the adjustment factor is assumed to rise by the same amount each year so as to facilitate calculations. This should be interpreted as the typical or average annual adjustment. It should be pointed out, however, that variation in the annual adjustment factor will have a corresponding impact on the fund balance.

8. There is a slight discrepancy here because the simulation algorithm calculates the adjustment factor as $[(1 + r)^{t-\frac{1}{2}}-1]$ where r represents the average annual adjustment factor and t represents the number of years for which adjustment is being paid. For $r = .05$ and $t = 1$, this expression yields .0247.

Assuming that the closure of cases is spread throughout the calendar year in roughly the same way as injuries are, the average number of active cases would simply be the number midway between the number active at the end of 1979 (3,050) and the number active at the end of 1980 (3,050 x .85 or 2,593). Therefore, table 6 shows that the average number of cases paid during 1980 is 2,822.

Now the total cost of adjusting all active 1978 cases in calendar year 1980 is the product of the annual base compensation amount ($7,216.56), times the average adjustment factor for these cases in 1980 (.0247), times the average number of cases paid during 1980 (2,822). The result (without rounding) is $502,918 and this would be the amount of the reimbursements during 1980. Further, an amount of $40,233 would be deducted for administrative expenses (8 percent of 1980 adjustment costs). So the total disbursements from the benefit adjustment fund during 1980 for 1978 injuries would be $543,151.

Interest earnings of the fund during 1980 would be 7 percent of the average balance during the year. But the beginning year balance of $85,594,500 would be held for six months until insurers filed for their reimbursements. Therefore, the first half of the year would net $2,995,808 in interest earnings. Assuming half the year's adjustment expenses were reimbursable on July 1 (actually, it would always be somewhat less than half), the average fund balance for the second half of the year would be $85,322,925 ($85,594,500 less 50 percent of $543,151). Interest earnings on this amount for half a year at 7 percent would be $2,986,302. Summing the interest earnings for the two halves of the year yields $5,982,110, the amount shown in the fifth column of table 6 for 1980. Finally, adding the interest income for 1980, subtracting adjustment payments and administrative expenses for 1980, we arrive at the 1980 year-end balance of the fund, $91,033,458.

This repetitive process is continued for each year up to 2028, or 50 years following the injury. The simulation model is driven simply by the retention function and the adjustment factors, which should serve to reemphasize the critical importance of the retention function in this operation. Under the 5 percent compound adjustment factor plan with a two-year waiting period shown in table 6, total annual adjustment costs for the 1978 injury cohort reach a peak of $9.9 million in 1998. Thereafter, adjustment costs decline slowly as the number of cases to be adjusted shrinks more rapidly than the adjustment factor for remaining cases rises.[9]

From the peak near $10 million, annual adjustment costs for the 1978 injury cohort fall gradually to $5 million by 2028 in the simulation presented in table 6. The later years are characterized by very large adjustment payments to a small number of cases. In 2028 the fully adjusted benefit is projected at nearly $77,000 per year. Thus each surviving case is extremely important in determining future adjustment costs.

The retention function projects that there will be 77 cases from 1978 active after 50 years. As mentioned earlier, this should be taken as a measure of the conservatism of the retention function itself. Of course no one can accurately predict what the extreme tail of the case duration distribution will look like, and we do not claim to do so either. Running the simulation for 50 years and then terminating with cases still active seems preferable to trying to estimate more closely when the precision is illusory anyway. The judgment as to whether the benefit adjustment case population is adequately estimated will be left to the reader. Suffice it to say

9. It might seem that adjustment costs would decline by 3 percent per year since the retention function after year 20 dictates that 8 percent of last year's cases will close while the effective compensation rate increases by 5 percent. However, a 5 percent increase in received weekly compensation is more than a 5 percent increase in the adjustment factor since total compensation is represented by one plus the adjustment factor.

that the tail of the active case distribution is extremely important to this single cohort simulation, but it would be much less important in the operation of a benefit adjustment fund as a whole.

While the $9.8 million in adjustment payments to the 1978 injury cohort in year 2000 (table 6) is the major item of interest for that year in a single cohort simulation, it would be only one of 20 cohorts receiving reimbursements from a benefit adjustment fund at that time. By the time the fund reached the year 2028, there would be 48 cohorts in payment status, and whether adjustment costs for the 1978 cohort amounted to $5.3 million or $4.3 million would be relatively less important to the benefit adjustment fund than it appears in table 6.[10]

It is also interesting to note that the peak year-end balance for the fund occurs in 1992 as benefit adjustment payments and administrative expenses overtake the interest earnings of the fund. Thus, for the first 14 years the fund balance is growing, and it is not until after 31 years that the balance is back down to the original assessment amount. In a sense, the first 30 years of adjustment payments are financed with the interest earnings of the fund. Taking the 50-year simulation period as a whole, projected benefit adjustment payments to the 1978 injury cohort total over $343,000,000 or slightly more than 100 percent of base year indemnity payments. Clearly, the bulk of these payments is financed with the projected interest earnings of the fund, which total more than $288,000,000 over the 50 years. Thus the assumption about the interest earnings of the fund is also critical. The higher the interest earnings of the fund, the lower the original assessment rate necessary to prefund the future benefits.

The assumption of 7 percent earnings on fund balances does appear conservative at the present time, but so does a 5

10. We will discuss the operation of the full fund later in this chapter.

percent adjustment factor for weekly benefits. To a considerable degree, it is not the absolute levels but the spread between these two critical parameters that conditions the solution to the prefunding problem.[11] Thus the critical assumption is that the rate of return on fund investments will be 2 percent per year *greater* than the adjustment factor, presumably based on price or wage increases. This amounts to assuming that the *real* rate of interest will be about 2 percent per annum in a world of 5 percent inflation. These levels are thought to be appropriate for a 50-year time span, but of course no one can tell for certain what the future will bring. That is one reason table 6 is properly termed a simulation rather than a prediction.

In summary, under the assumptions about the duration of workers' compensation disability cases that are contained in the retention function presented earlier, and given the parameters of the benefit adjustment plan that we have just discussed, it is projected that an assessment of about 25 percent against 1978 indemnity payments (yielding $82.7 million) will be sufficient to prefund 50 years of benefit adjustment payments to the 1978 cohort of injured workers. Of course, an assessment of 24.7 percent against annual indemnity payments would constitute a lesser proportion of all annual benefits. Since medical payments in Michigan are about 25 percent of total annual benefit payments, the 24.7 percent assessment would amount to an 18.5 percent increase in annual benefit payments (24.7 x .75). This makes inflation protection an expensive item, but not impossibly so.

Furthermore, this cost level compares very favorably with the National Council on Compensation Insurance estimate

11. Actually, the prefunded assessment level responds to the two parameters in very different ways. The interest earnings are most important in early years as the adjustment payments are still small and the fund balance grows rapidly. But the compound interest effect of the annual adjustment factor dominates the distant future. We will examine the sensitivity of the required funding level to these parameters in the following chapter.

of 31.1 percent for a 5 percent annual cap plan prepared for the Michigan Workers' Compensation Reform Task Force in September 1979.[12] Unfortunately, it is not possible to determine what part of this difference may be due to the special operating circumstances of a state fund and what part is due to different assumptions about the case load on the fund or other parameters. We will, however, in the next chapter, examine the sensitivity of our estimate to assumptions about the adjustment factor, the interest earnings rate, and the number of cases to be adjusted.

Before abandoning the question of the cost impact of a benefit adjustment program such as that discussed here, one additional issue should be raised. While we will present the cost of benefit adjustment principally in terms of the prefunding assessment level required, this dollar amount is capable of expression in a number of different ways. Most frequently, we will refer simply to the assessment rate on base year indemnity that would be necessary to raise the required funds. But, as was just demonstrated, this is not a fair measurement of the cost impact of the program relative to total workers' compensation benefits paid, due to the exclusion of medical benefits from the assessment base.

Similarly, the cost of benefit adjustment relative to total benefits (including medical) does not fairly represent the true cost impact on the workers' compensation insurance premium dollar. For example, the $82.7 million assessment level necessary to prefund lifetime inflation adjustment payments to the 1978 Michigan injury cohort under the assumptions of table 6 would only constitute 10.3 percent of the 1978 Standard Earned Premium in Michigan of $800.4 million. Further, if it is assumed that the insured and self-insured sectors contribute proportionally to the long term

12. There are actually two discrepancies between the estimates. The NCCI estimate was for a program to begin with the 1980 cohort and did not include the two-year waiting period.

disabled claimant population, then only about 60 percent of the benefit adjustment case burden would be from the insured sector. Thus the insured sector's share of the assessment would be \$49.6 million, which would amount to only 6.2 percent of the 1978 Standard Earned Premium.

To avoid confusion, we will refer to costs in dollars and the assessment rate required to raise the necessary funds for benefit adjustment purposes, but this should not obscure the fact that the assessment rate does not adequately represent the cost impact of such a program. Let us proceed to examine some other issues that bear on the question of the interpretation to be given to the simulation estimates developed here.

Evaluation of Cost Estimate

While this estimate of the forward funding level required to make lifetime benefit adjustment payments to the 1978 injury cohort has been carefully prepared, it is a certainty that it will be incorrect. These projections are very rough and we shall see in the next chapter that the forward funding level is very sensitive to the adjustment factors, the interest earnings rate, and the number of cases to be adjusted. These key parameters are largely outside policy control, yet they must be estimated far in advance to determine the forward funding required. But it is simply not possible to eliminate the great uncertainties inherent in dealing with the future. The real question is, "by how much and in what direction will we miss the true assessment level needed to prefund the plan?" If the plan is overfunded, it would be a relatively simple matter to reduce the assessment rates for subsequent cohorts to bring them into line with actual experience. The excess funds could be refunded or used as a reserve for future contingencies.

On the other hand, if the plan turns out to be underfunded, more difficult adjustments will be required. There would seem to be three choices, general fund revenues, supplemental assessments, or commingling of funds for different cohorts. The injection of general fund revenues would be an obvious solution to an assessment shortfall; whether that is tenable, or preferable, must be left to future legislatures to decide. Supplemental assessments would be another possible solution. However, if the benefit adjustment funds for different cohorts are not to be commingled, it would be necessary to level the supplemental assessment on the particular cohort involved. If the shortfall were not discernible for 10 or 20 years after the injury year, this would give rise to some very difficult administrative questions.

But if funds for different cohorts *were* commingled, much of this could be avoided. We have seen that a major share of the benefit adjustment payments is provided by the interest earnings of the fund, and that the annual interest earnings exceed annual adjustment costs for many years of fund operation. Under these circumstances, commingling of funds from different cohorts could be accomplished without abandoning the prefunding principle. With careful accounting allocations, each cohort could be tracked separately for the purpose of determining the adequacy of the original assessment in the long-run. Yet the assessment process could be smoothed to some degree by implicit borrowing between cohort assessments.

Thus, the original assessment rate would be set at a level that is expected to yield lifetime adjustment benefits for each injury cohort. If, however, the assessment subsequently proves unequal to the task, payments are continued from the fund, with corrections made in future assessment rates to bring the whole fund into balance. Given the fund simulations presented here, it is apparent that a shift of a few million dollars would have enormous corrective potential if implemented soon enough. Of course this process would be reversible in the case of over-sufficiency of assessment levels. Such a procedure, while not seriously compromising the prefunding principle, would offer a mechanism for adjusting the fund to future realities as they are revealed. Thus commingling of funds with separate internal accounting for each cohort would seem to be indicated.

While a cautious approach to the important determinants of benefit adjustment costs can help prevent embarrassment later, there is really nothing that can be done about potential utilization levels. The retention function employed here is rooted irrevocably in *current* claims experience, as revealed in some simple Bureau of Workers' Disability Compensation statistics. But the current system does *not* provide benefit adjustment payments to all claimants. Thus, if there is a behavioral response to the imposition of a benefit adjustment fund, either by insurers or by claimants, we will find ourselves in uncharted waters.

As an example, consider the situation with regard to redemptions. Whatever the motivation of the parties to a redemption (or compromise and release settlement), it is clear that they have agreed to the settlement. The existence of a benefit adjustment program would change the situation materially. If everything else in the system remains as it was, the present value of the typical permanent disability claim will rise to reflect the future escalated benefits. This might fundamentally affect the attractiveness of a redemption to one or both parties. But consider the impact on the benefit adjustment fund of any change in the status quo.

Redemption payments are included in the assessment base for the year in which they are paid. But no continuing claim is associated with that payment, so there will be no benefit adjustment payments in the future emanating from the redeemed claim. Thus the redemption contributes to the assessment side of the fund, but does not participate on the disbursement side. If the proportion of redemptions was to increase as a result of imposing a benefit adjustment fund, the financial position of the fund would be strengthened. But suppose the proportion of redemptions were to decline; then the financial health of the fund could be threatened. Clearly, the anticipated benefit adjustment payments would be greater than otherwise because the number of cases to be adjusted in the future would be greater. The impact on the assessment side would depend on the relative dollar magnitude of the redemption settlements, but it is not unlikely that the total redemption dollars might decline, further compounding the problem. In any event, the fund would be faced with a changed world, but holding resources calculated to cope with the old world.

Finally, we come to the question of overall program effects. All the estimated costs mentioned in this simulation have been direct costs, allowing for no interactions with other aspects of the workers' compensation system. We have just seen one example of such a potential interaction that could have unforeseeable impact on a benefit adjustment fund, but there would be others as well. First and most obvious would be the present Second Injury Fund. Presumably, a benefit adjustment fund would take over a good deal of the future burden of the Second Injury Fund since permanent and total disabilities would be adjusted right along with others, thus reducing the need for future differential payments from the Second Injury Fund. The magnitude of this overlap is not clear, but the case load of the Second Injury Fund should stabilize and then gradually decline in the future through attrition. These unknown savings should be counted as a net reduction from the cost of a benefit adjustment fund.

A second possible impact would involve coordination of benefits. If workers' compensation benefits are to be coordinated in the future with Social Security payments, private pensions, or other income maintenance programs as proposed before the Michigan Workers' Compensation Reform Task Force, this too would presumably have an impact on the benefit adjustment fund. It would seem reasonable that any coordination of benefits would reduce the burden on the fund by reducing the effective compensation rate that is being adjusted. Once again, the dollar savings from this interaction are completely unknown, but they would reduce the net cost of a benefit adjustment fund.

Third, any specific statutory change might affect qualification for benefit adjustment payments. By using all active cases in the estimation of the retention function, we have implicitly assumed that no cases would be disqualified from benefit adjustment.[13] But some Michigan proposals have excluded partial disabilities, scheduled disabilities, or even fatalities from adjustment. If a proposal were adopted that provided for some specific disqualifications, this would clearly lower the number of cases eligible for adjustment and, hence, the costs of a benefit adjustment plan. The same result might be produced by a change in the definition of disability, although this would be more likely to affect the entire case population in the same way, thus reducing the assessment base as well as the future case population eligible for benefit adjustment.

One change that should not substantially affect the results presented here would be a change in the benefit formula, or a change in the maximums or minimums. While these changes would influence the average compensation rate which is to be adjusted in the future, they should impact on the assessment

13. We will touch this issue again in chapter 5 when alternative fund formulations are discussed.

base in a proportional manner.[14] Thus the assessment rate necessary to prefund benefit adjustment payments should not be changed.

In recognition of all these uncertainties, the cost estimates presented here are to be taken as indicative rather than definitive, a sketch rather than a blueprint. They seem to be conservatively estimated, but only the passage of time can reveal the truth.

Full Fund Operation

The single cohort analysis is very effective in describing the nature of the fund operation in a "deposit and withdrawal" sense. It is also a necessary tool for making cost comparisons of alternative plans and various states of the world. Without the present value content of the single cohort analysis it would be very difficult to compare different situations. But the single cohort analysis does tend to conceal another important feature in the operation of a benefit adjustment fund, and that is the magnitude of the fund balances that will be generated.

In table 6 it was projected that the $82.7 million in forward funding for the 1978 cohort, which would be received at the middle of 1979, would grow to a balance of $125 million in 1992 before it begins to gradually decline. But by 1992 there will have been assessments levied on 13 other injury cohorts, and they can be expected to follow the general pattern shown in table 6 as well. Thus the fund will hold a huge reserve against future liabilities. This is not to say that the reserves are out of line with the liabilities, simply that the absolute magnitude of the reserves may be unsettling. To fairly assess the proposal for a state benefit adjustment fund, it is necessary to examine the operation of the full fund.

14. But see the discussion of the assessment base in chapter 5 for a more complete treatment of this issue.

In order to deal with the operation of a fund that will have responsibility for benefit adjustment payments to all cohorts (rather than just one), it is necessary to project future workers' compensation indemnity cost levels. We need to predict how adjustment costs will rise as we add additional injury cohorts year by year, while at the same time providing additional benefit adjustment increments to older injury cohorts. But we also need to predict changes in the assessment base, that is, total indemnity payments to all previous cohorts for each future year.

None of these things can be done adequately due to the lack of data, but it is possible to provide an illustrative exercise based on some of the same simple assumptions employed earlier in the chapter. To be consistent with the simulation exercise of table 6, let us assume that the average weekly compensation rate will increase by 5 percent per year. Let us further assume that the number of workers' compensation claims will increase by 4 percent per year on the average.[15] If there is no significant change in the average duration of disability, the result of these assumptions will be an increase of 9.2 percent in indemnity costs from one injury cohort to the next.

Under this hypothetical set of circumstances, total weekly indemnity payments would rise by 9.2 percent annually as well, once the case population had matured. But we start the exercise with a case population characterized by a finite origin, the year 1965 when lifetime benefits were made available to general disability claimants under Michigan statute. Because of this finite origin problem, total weekly compensation payments will tend to grow more rapidly than the baseline figure of 9.2 percent for a number of years. With a stable assessment rate, this would result in slightly

15. In fact, the rate of increase in voluntarily paid workers' compensation claims in Michigan over the period 1972-1978 was 3.9 percent per year.

higher assessment income than otherwise expected. This complication has been ignored in the results to be presented here, but it should provide an additional safety margin in the operation of the fund.

It is also necessary to make some assumption about the future course of redemption settlements, since they constitute an important part of the assessment base as well. While there are a number of choices here, the simplest has been elected. It is assumed that total redemption payments will rise at the same rate as total weekly indemnity, namely 9.2 percent annually. Given these hypothetical ''facts''about the assessment base, and employing the method described earlier for estimating the annual adjustment costs for each cohort, it is possible to simulate the operation of a benefit adjustment fund for all cohorts.

Table 7 shows what could be expected. Assessment income would increase by 9.2 percent each year, reflecting both the increase in the assessment base and the anticipated cost of future adjustment payments. Annual adjustment payments would rise very rapidly as each year a new cohort would come into adjustment status and all previous cohorts would receive another year's credit in their adjustment factor. The only offsetting factor would be the closure of some cases from each cohort, as specified in the retention function. But despite the rapid rise in adjustment payments, they never even overtake the annual interest earnings of the fund. Thus, the fund balance will continue to grow indefinitely, rising from a projected $85.6 million at the end of 1979 to $569.2 million in 1983, $1.1 billion in 1986, $2.1 billion in 1990, $4.0 billion in 1995, and so on.

While these numbers are not to be taken seriously as predictions, they are illustrative of the dynamics of a prefunded operation. Because of the long time horizon necessary when dealing with lifetime benefit adjustment

Table 7
Full Fund Operation - All Cohorts, 1978-2028

Year	Assessment Income (millions)	Adjustment Costs (millions)	Interest Earnings (millions)	Year-end Balance (millions)
1979	$ 82.7	$ 0	$ 2.9	$ 85.6
1980	90.3	.5	9.1	184.5
1981	98.6	2.0	16.3	297.4
1982	107.7	4.3	24.4	425.3
1983	117.6	7.4	33.6	569.2
1984	128.4	11.4	43.9	730.2
1985	140.2	16.4	55.4	909.5
1986	153.1	22.5	68.2	1,108.3
1987	167.2	29.8	82.4	1,328.1
1988	182.6	38.5	98.0	1,570.3
1989	199.4	48.5	115.2	1,836.5
1990	217.7	60.0	134.1	2,128.3
1991	237.8	73.1	154.7	2,447.8
1992	259.7	88.0	177.4	2,796.9
1993	283.5	104.7	202.0	3,177.7
1994	309.6	123.6	229.0	3,592.7
1995	338.1	144.6	258.3	4,044.4
1996	369.2	168.1	290.1	4,535.6
1997	403.2	194.3	324.8	5,069.3
1998	440.3	222.8	362.5	5,649.2
1999	480.8	254.0	403.4	6,279.4
2000	525.0	288.0	447.9	6,964.3
2001	573.3	325.0	496.2	7,708.9
2002	626.1	365.2	548.8	8,518.5
2003	683.7	409.2	605.9	9,399.0
2004	746.6	457.0	668.1	10,356.7
2005	815.3	509.1	735.7	11,398.6
2006	890.3	565.8	809.3	12,532.4
2007	972.5	627.5	889.3	13,766.4
2008	1,061.6	694.8	976.5	15,109.7
2009	1,159.3	768.1	1,071.4	16,572.2
2010	1,265.9	848.1	1,174.7	18,164.8
2011	1,382.4	935.0	1,287.2	19,899.4
2012	1,509.6	1,029.8	1,409.8	21,789.0
2013	1,648.4	1,133.2	1,543.2	23,847.4
2014	1,800.1	1,245.8	1,688.7	26,090.4
2015	1,965.7	1,368.7	1,847.2	28,534.6
2016	2,146.6	1,502.6	2,019.9	31,198.5
2017	2,344.0	1,648.6	2,208.2	34,102.1
2018	2,559.7	1,808.0	2,413.4	37,267.2
2019	2,795.2	1,981.7	2,637.2	40,717.9
2020	3,052.3	2,171.3	2,881.1	44,480.0
2021	3,333.2	2,378.1	3,147.0	48,582.1
2022	3,639.8	2,603.7	3,437.7	53,055.2
2023	3,974.7	2,849.9	3,753.3	57,933.3
2024	4,340.3	3,118.3	4,098.1	63,253.4
2025	4,739.7	3,411.7	4,474.2	69,055.6
2026	5,175.7	3,731.7	4,884.4	75,384.0
2027	5,651.9	4,080.9	5,331.9	82,286.9
2028	6,171.8	4,462.1	5,819.9	89,816.5

payments, the gross annual payout is smaller than both the annual assessment income and the annual interest earnings of the fund. The result is a massive reserve account. There is some question whether it would be desirable to accumulate such reserves in the public sector. Of course, much would depend on just what sort of investment strategy would be followed by the trustees of the fund. But it is interesting to note that fears of the potential economic impact of the reserve fund precipitated intense debate in the early years of the Old Age Insurance System (Social Security).[16]

The original financing plan for Social Security called for a payroll tax (combined employee and employer shares) which would rise gradually to 6 percent in 1949. The yield from this tax, when combined with the interest earnings of the reserve funds, was projected to be sufficient to pay the entire cost of the program for the foreseeable future. The reserve funds to be accumulated were quite large, projected to grow to $47 billion by 1980, and would eventually provide interest earnings that would pay 40 percent of the benefits. In other words, the payroll tax was to carry 60 percent of the annual cost burden, and interest earnings on the reserves the remainder. But the absolute magnitude of the reserve fund came under Republican attack in 1937. According to Senator Vandenberg, "It is scarcely conceivable that rational men should propose such an unmanageable accumulation of funds in one place in a democracy."[17] While the debate that ensued raised many basic issues of financing, fears of the large reserves may be said to have started the evolution toward the compromise plan that amounted to pay-as-you-go funding with a small reserve account.

16. See Martha Derthick *Policymaking for Social Security Washington, DC: Brookings Institution, 1979),* Ch. 11, for a discussion of the issues and the solutions to the Social Security financing problems.

17. Congressional Record (March 17, 1937), p. 2324, quoted in Derthick, p. 232.

The reserves of a Michigan benefit adjustment fund for workers' compensation claimants would clearly be small compared with those of a prefunded OASDI program. However, in principle the concerns are similar. Some people would fear the tendency to liberalize benefits as a consequence of the size of the fund. Some would question the wisdom of a government agency draining funds from business firms that may be short of working capital in the first place. Presumably, some would ask why such sums should be collected now when they will not be needed for many years, as they did in the Social Security debates. These issues and many more need airing in public debate. The purpose of this paper is to help prompt that debate.

The magnitude of the reserves that apparently would be generated in a benefit adjustment fund also puts a different perspective on some of the fund management problems raised in the last section. From the evidence of table 7, it would appear that simply detecting overfunding or underfunding may be a problem. Thus, the strategy of separate tracking of each cohort would appear to be of critical importance to the management of the fund. Only by reference to the separate single cohorts could the true health of the benefit adjustment fund be determined.

Having completed the review of the operation of a benefit adjustment fund under one set of assumptions about the real world, let us go on to examine the sensitivity of the estimated single cohort forward funding level to these assumptions. In the next chapter the impact of the average annual adjustment factor, the fund interest earnings rate, and the number of cases to be adjusted will be considered.

CHAPTER 4
Sensitivity Analysis

The last chapter presented a simulation of the operation of a benefit adjustment fund for workers' compensation cases in Michigan under one set of assumptions about the nature of the world in which the fund would operate. But there are two very important reasons to examine alternative states of the world.

First, given the certainty that we will not correctly anticipate the future, it is important to know what the probable range of variation will be. For instance, we used an assumed average annual adjustment factor of 5 percent in the last chapter. It was necessary to choose some number to do the simulation, and 5 percent is justifiable on historical grounds; but we cannot be very confident that it (or any other particular number) will be correct.

On the other hand, it is possible to be much more confident that the long-run annual average inflation rate will fall in the range of 4 to 8 percent. Then, if the forward funding level required for each of these likely inflation rates is known, we can choose the assessment level that satisfies our requirement for safety from serious underassessment. In fact, it will be shown that this choice is a prerequisite to establishing a benefit adjustment fund.

Second, a sensitivity analysis is valuable as a way of verifying the stability of the simulation solution. It is reassuring to know that the forward funding level required changes in a regular, predictable way with changes in the parameters. This chapter will demonstrate that the benefit adjustment fund simulation has this characteristic. Variation in the three major external parameters—the annual adjustment factor, the interest earnings rate, and the number of cases to be adjusted—will be examined.

Sensitivity to Adjustment Factor and Interest Rate

Table 8 presents the simulation for the 1978 injury cohort of a prospective benefit adjustment plan that would pay a 6 percent compound benefit increase for every year after the waiting period of two years. Again, the interpretation of the 6 percent would be that it was the average annual adjustment. All fund parameters are the same as before, except for the adjustment factor. The number of cases to be adjusted is the same, the interest earnings rate is the same, and the administrative cost rate is the same. However, the assessment necessary to prefund this plan is $109.2 million, or 32.6 percent of total 1978 indemnity payments.

Adjustment costs are greater in every year than under the plan presented in table 6, but the difference becomes considerable as one moves farther into the future. This is strictly the result of the compound interest effect on the adjustment factor. For instance, in year 2010 the 5 percent simulation of table 6 provides an adjustment payment of about three-and-one-half times the original benefit, whereas the 6 percent simulation pays nearly a five-fold adjustment. Under the former plan, the average annual adjusted compensation rate for 1978 cases would be nearly $32,000 in 2010, whereas under the latter it would exceed $42,000.

Under the 6 percent adjustment simulation, the annual cost of adjustment peaks in year 2000 at just over $13.1

Table 8
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$ 3,822,000	$113,022,000
1980	2,822	.0296	602,055	7,900,161	120,271,942
1981	2,399	.0913	1,581,073	8,389,154	126,953,537
1982	2,039	.1568	2,307,375	8,843,138	133,304,710
1983	1,876	.2262	3,062,355	9,273,451	139,270,818
1984	1,726	.2998	3,733,634	9,678,392	144,916,885
1985	1,657	.3778	4,516,683	10,058,817	150,097,683
1986	1,590	.4605	5,284,820	10,406,955	154,797,032
1987	1,527	.5481	6,038,931	10,721,656	158,996,643
1988	1,466	.6410	6,779,870	11,001,625	162,676,009
1989	1,407	.7394	7,508,463	11,245,411	165,812,280
1990	1,351	.8438	8,225,509	11,451,397	168,380,127
1991	1,297	.9544	8,931,779	11,617,798	170,351,603
1992	1,245	1.0717	9,628,020	11,742,643	171,695,985
1993	1,195	1.1960	10,314,952	11,823,766	172,379,602
1994	1,147	1.3277	10,993,276	11,858,799	172,365,664
1995	1,101	1.4674	11,663,666	11,845,153	171,614,057
1996	1,057	1.6155	12,326,780	11,780,008	170,081,143
1997	1,015	1.7724	12,983,250	11,660,297	167,719,529
1998	934	1.9387	13,065,624	11,493,427	165,102,082
1999	859	2.1150	13,113,605	11,309,299	162,248,687
2000	790	2.3019	13,130,636	11,109,239	159,176,839
2001	727	2.5001	13,119,865	10,894,413	155,901,798
2002	669	2.7101	13,084,172	10,665,835	152,436,728
2003	615	2.9327	13,026,189	10,424,376	148,792,820
2004	566	3.1686	12,948,324	10,170,774	144,979,404
2005	521	3.4188	12,852,775	9,905,641	141,004,048
2006	479	3.6839	12,741,550	9,629,468	136,872,641
2007	441	3.9649	12,616,482	9,342,633	132,589,474
2008	406	4.2628	12,479,242	9,045,406	128,157,299
2009	373	4.5786	12,331,353	8,737,948	123,577,386
2010	343	4.9133	12,174,204	8,420,325	118,849,570
2011	316	5.2681	12,009,059	8,092,499	113,972,285
2012	291	5.6442	11,837,068	7,754,339	108,942,591
2013	267	6.0428	11,659,275	7,405,621	103,756,195
2014	246	6.4654	11,476,630	7,046,025	98,407,460
2015	226	6.9133	11,289,995	6,675,141	92,889,407
2016	208	7.3881	11,100,149	6,292,466	87,193,712
2017	192	7.8914	10,907,800	5,897,402	81,310,690
2018	176	8.4249	10,713,586	5,489,262	75,229,279
2019	162	8.9904	10,518,085	5,067,258	68,937,006
2020	149	9.5898	10,321,816	4,630,508	62,419,953
2021	137	10.2252	10,125,249	4,178,029	55,662,714
2022	126	10.8987	9,928,803	3,708,736	48,648,342
2023	116	11.6126	9,732,856	3,221,433	41,358,290
2024	107	12.3694	9,537,746	2,714,817	33,772,341
2025	98	13.1715	9,343,773	2,187,467	25,868,532
2026	90	14.0218	9,151,206	1,637,839	17,623,069
2027	83	14.9231	8,960,282	1,064,266	9,010,230
2028	77	15.8785	8,771,211	464,940	2,262

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 6 percent compound
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$109,200,000**

million, about one-third higher than the earlier figure. Because of the compound interest effect, annual adjustment payments to the 1978 cohort in 2028 would be almost two-thirds greater than in the previous simulation. Adjustment costs for the full 50-year simulation total over $480 million, or 40 percent more than in the 5 percent simulation.

Table 9 presents the results of a benefit adjustment fund simulation using a 4 percent compound adjustment factor. The required prefunding level for this plan is $60.5 million, or 18.1 percent of 1978 indemnity payments. In this simulation, annual adjustment costs for the 1978 cohort reach their peak in 1997 at only $7.2 million. Fund disbursements (adjustment costs and administrative expenses) surpass interest earnings of the fund in 1992. Total 50-year adjustment costs for the 1978 cohort are projected at $237.7 million, or about 71 percent of 1978 indemnity payments.

Apparently the prefunding level required for a benefit adjustment plan of the sort contemplated here is very sensitive to the adjustment factor. When the annual adjustment factor was increased from 5 to 6 percent, the 20 percent increase in the adjustment factor produced a 32 percent increase in required assessment level. When the adjustment factor was reduced from 5 to 4 percent, the 20 percent decrease produced a 27 percent cut in funding required. Thus, the forward funding level appears to respond more than proportionally to changes in the annual adjustment factor.

However, by varying only the annual adjustment factor we are in effect also varying the *real* rate of interest, since it is unrealistic to suppose that the interest earnings of the fund would not vary with the adjustment factor. In the long-run, both should reflect the underlying inflation rate in the economy. But when the adjustment factor was advanced from 5 percent in table 6 to 6 percent for table 8, the differential of the interest rate over the rate of wage increase

Table 9
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,117,500	$62,617,500
1980	2,822	.0198	403,309	4,375,602	66,557,529
1981	2,399	.0606	1,048,940	4,639,202	70,063,876
1982	2,039	.1030	1,515,815	4,875,822	73,302,618
1983	1,876	.1471	1,991,800	5,093,538	76,245,012
1984	1,726	.1930	2,403,905	5,291,717	78,940,512
1985	1,657	.2407	2,878,283	5,471,436	81,303,402
1986	1,590	.2904	3,332,774	5,628,249	83,332,255
1987	1,527	.3420	3,768,173	5,762,039	85,024,668
1988	1,466	.3957	4,185,247	5,872,626	86,377,227
1989	1,407	.4515	4,584,729	5,959,755	87,385,474
1990	1,351	.5096	4,967,324	6,023,101	88,043,865
1991	1,297	.5699	5,333,711	6,062,263	88,345,720
1992	1,245	.6327	5,684,538	6,076,763	88,283,182
1993	1,195	.6980	6,020,420	6,066,037	87,847,156
1994	1,147	.7660	6,341,983	6,029,437	87,027,252
1995	1,101	.8366	6,649,775	5,966,227	85,811,722
1996	1,057	.9101	6,944,357	5,875,572	84,187,389
1997	1,015	.9865	7,226,259	5,756,541	82,139,570
1998	934	1.0659	7,183,657	5,613,999	79,995,219
1999	859	1.1486	7,121,329	5,465,072	77,769,256
2000	790	1.2345	7,041,853	5,310,757	75,474,812
2001	727	1.3239	6,947,557	5,151,928	73,123,378
2002	669	1.4169	6,840,542	4,989,350	70,724,943
2003	615	1.5135	6,722,701	4,823,687	68,288,113
2004	566	1.6141	6,595,736	4,655,509	65,820,227
2005	521	1.7186	6,461,180	4,485,300	63,327,452
2006	479	1.8274	6,320,407	4,313,466	60,814,878
2007	441	1.9405	6,174,646	4,140,341	58,286,601
2008	406	2.0581	6,025,001	3,966,190	55,745,790
2009	373	2.1804	5,872,452	3,791,216	53,194,758
2010	343	2.3076	5,717,874	3,615,565	50,635,019
2011	316	2.4399	5,562,046	3,439,329	48,067,338
2012	291	2.5775	5,405,654	3,262,547	45,491,779
2013	267	2.7206	5,249,308	3,085,213	42,907,739
2014	246	2.8695	5,093,541	2,907,274	40,313,989
2015	226	3.0242	4,938,823	2,728,635	37,708,695
2016	208	3.1852	4,785,563	2,549,162	35,089,448
2017	192	3.3526	4,634,117	2,368,677	32,453,279
2018	176	3.5267	4,484,789	2,186,967	29,796,674
2019	162	3.7078	4,337,843	2,003,782	27,115,585
2020	149	3.8961	4,193,502	1,818,834	24,405,436
2021	137	4.0919	4,051,952	1,631,799	21,661,127
2022	126	4.2956	3,913,348	1,442,317	18,877,028
2023	116	4.5074	3,777,816	1,249,991	16,046,978
2024	107	4.7277	3,645,458	1,054,389	13,164,273
2025	98	4.9569	3,516,350	855,040	10,221,655
2026	90	5.1951	3,390,549	651,434	7,211,297
2027	83	5.4429	3,268,094	443,024	4,124,779
2028	77	5.7007	3,149,008	229,218	953,068

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 4 percent compound
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$60,500,000**

was reduced from 2 percent to 1 percent. Contrarily, when comparing the 5 percent simulation to the 4 percent, the real interest rate was effectively increased from 2 percent to 3 percent. Thus we have confounded the effects of changes in two critical parameters.

Table 10 presents the simulation of a 6 percent compound benefit adjustment plan with an 8 percent return on fund balances, thus restoring a real rate of interest of 2 percent. The necessary forward funding for the plan under these assumptions is $92.2 million, or 27.5 percent of 1978 indemnity. This level of funding will provide the same $480 million in future benefit adjustment payments to the 1978 injury cohort as were detailed in table 8. However, with the restoration of the 2 percent differential between the rate of interest earnings and the rate of benefit adjustment, the necessary assessment rate has declined from 32.6 percent to 27.5 percent of 1978 indemnity payments.

Table 11 shows that the opposite happens with the 4 percent adjustment plan when the real interest rate is reduced from 3 to 2 percent. The assessment level necessary to prefund the plan rises from 18.1 percent in table 9 to 21.4 percent here. In both cases, the assessment levels have moved halfway back to the 24.7 percent level of the 5 percent plan of table 6. Thus, the earlier conclusions about the sensitivity of the assessment rate to the adjustment factor were premature.

Table 12 shows the dollar level and (in parentheses) the assessment rate necessary to prefund benefit adjustment plans for the 1978 injury cohort (under the assumptions detailed heretofore) with various combinations of annual adjustment factors and interest earnings rates. Annual adjustment factors from 4 percent to 8 percent and interest rates from 6 percent to 10 percent are reported. Real interest rates of from 1 to 3 percent (obtained by subtracting the annual

Table 10
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$ 3,688,000	$ 95,888,000
1980	2,822	.0296	602,055	7,658,036	102,895,817
1981	2,399	.0913	1,581,073	8,197,514	109,385,772
1982	2,039	.1568	2,307,375	8,701,022	115,594,829
1983	1,876	.2262	3,062,355	9,181,439	121,468,926
1984	1,726	.2998	3,733,634	9,636,868	127,073,468
1985	1,657	.3778	4,516,683	10,068,317	132,263,767
1986	1,590	.4605	5,284,820	10,466,949	137,023,111
1987	1,527	.5481	6,038,931	10,831,408	141,332,473
1988	1,466	.6410	6,779,870	11,160,153	145,170,366
1989	1,407	.7394	7,508,463	11,451,446	148,512,672
1990	1,351	.8438	8,225,509	11,703,343	151,332,465
1991	1,297	.9544	8,931,779	11,913,671	153,599,814
1992	1,245	1.0717	9,628,020	12,080,020	155,281,573
1993	1,195	1.1960	10,314,952	12,199,723	156,341,147
1994	1,147	1.3277	10,993,276	12,269,837	156,738,246
1995	1,101	1.4674	11,663,666	12,287,124	156,428,611
1996	1,057	1.6155	12,326,780	12,248,030	155,363,719
1997	1,015	1.7724	12,983,250	12,148,659	153,490,468
1998	934	1.9387	13,065,624	11,997,020	151,376,614
1999	859	2.1150	13,113,605	11,826,875	149,040,796
2000	790	2.3019	13,130,636	11,639,642	146,499,351
2001	727	2.5001	13,119,865	11,436,559	143,766,455
2002	669	2.7101	13,084,172	11,218,698	140,854,248
2003	615	2.9327	13,026,189	10,986,974	137,772,938
2004	566	3.1686	12,948,324	10,742,151	134,530,900
2005	521	3.4188	12,852,775	10,484,852	131,134,755
2006	479	3.6839	12,741,550	10,215,563	127,589,444
2007	441	3.9649	12,616,482	9,934,639	123,898,282
2008	406	4.2628	12,479,242	9,642,311	120,063,012
2009	373	4.5786	12,331,353	9,338,684	116,083,835
2010	343	4.9133	12,174,204	9,023,744	111,959,439
2011	316	5.2681	12,009,059	8,697,359	107,687,014
2012	291	5.6442	11,837,068	8,359,280	103,262,261
2013	267	6.0428	11,659,275	8,009,141	98,679,385
2014	246	6.4654	11,476,630	7,646,456	93,931,080
2015	226	6.9133	11,289,995	7,270,622	89,008,508
2016	208	7.3881	11,100,149	6,880,917	83,901,265
2017	192	7.8914	10,907,800	6,476,493	78,597,334
2018	176	8.4249	10,713,586	6,056,373	73,083,034
2019	162	8.9904	10,518,085	5,619,452	67,342,955
2020	149	9.5898	10,321,816	5,164,485	61,359,879
2021	137	10.2252	10,125,249	4,690,085	55,114,696
2022	126	10.8987	9,928,803	4,194,714	48,586,302
2023	116	11.6126	9,732,856	3,676,674	41,751,492
2024	107	12.3694	9,537,746	3,134,104	34,584,830
2025	98	13.1715	9,343,773	2,564,961	27,058,515
2026	90	14.0218	9,151,206	1,967,015	19,142,228
2027	83	14.9231	8,960,282	1,337,836	10,802,959
2028	77	15.8785	8,771,211	674,779	2,004,830

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 6 percent compound
Interest earnings: 8 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$92,200,000**

Table 11
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,148,000	$73,748,000
1980	2,822	.0198	403,309	4,418,346	77,730,773
1981	2,399	.0606	1,048,940	4,646,854	81,244,771
1982	2,039	.1030	1,515,815	4,850,130	84,457,821
1983	1,876	.1471	1,991,800	5,035,202	87,341,879
1984	1,726	.1930	2,403,905	5,201,569	89,947,231
1985	1,657	.2407	2,878,283	5,350,206	92,188,891
1986	1,590	.2904	3,332,774	5,477,343	94,066,838
1987	1,527	.3420	3,768,173	5,582,966	95,580,177
1988	1,466	.3957	4,185,247	5,667,010	96,727,120
1989	1,407	.4515	4,584,729	5,729,355	97,504,968
1990	1,351	.5096	4,967,324	5,769,827	97,910,084
1991	1,297	.5699	5,333,711	5,788,199	97,937,876
1992	1,245	.6327	5,684,538	5,784,183	97,582,758
1993	1,195	.6980	6,020,429	5,757,435	96,838,130
1994	1,147	.7660	6,341,983	5,707,548	95,696,336
1995	1,101	.8366	6,649,775	5,634,054	94,148,633
1996	1,057	.9101	6,944,357	5,536,419	92,185,146
1997	1,015	.9865	7,226,259	5,414,043	89,794,830
1998	934	1.0659	7,183,657	5,271,315	87,307,796
1999	859	1.1486	7,121,329	5,123,102	84,739,863
2000	790	1.2345	7,041,853	4,970,314	82,104,975
2001	727	1.3239	6,947,557	4,813,748	79,415,361
2002	669	1.4169	6,840,542	4,654,105	76,681,681
2003	615	1.5135	6,722,701	4,491,993	73,913,157
2004	566	1.6141	6,595,736	4,327,938	71,117,700
2005	521	1.7186	6,461,180	4,162,391	68,302,017
2006	479	1.8274	6,320,407	3,995,730	65,471,708
2007	441	1.9405	6,174,646	3,828,273	62,631,363
2008	406	2.0581	6,025,001	3,660,277	59,784,639
2009	373	2.1804	5,872,452	3,491,945	56,934,336
2010	343	2.3076	5,717,874	3,323,431	54,082,462
2011	316	2.4399	5,562,046	3,154,843	51,230,296
2012	291	2.5775	5,405,654	2,986,246	48,378,436
2013	267	2.7206	5,249,308	2,817,667	45,526,851
2014	246	2.8695	5,093,541	2,649,096	42,674,922
2015	226	3.0242	4,938,823	2,480,486	39,821,480
2016	208	3.1852	4,785,563	2,311,763	36,964,834
2017	192	3.3526	4,634,117	2,142,817	34,102,805
2018	176	3.5267	4,484,789	1,973,515	31,232,747
2019	162	3.7078	4,337,843	1,803,692	28,351,568
2020	149	3.8961	4,193,502	1,633,159	25,455,746
2021	137	4.0919	4,051,952	1,461,703	22,541,341
2022	126	4.2956	3,913,348	1,289,084	19,604,010
2023	116	4.5074	3,777,816	1,115,040	16,639,008
2024	107	4.7277	3,645,458	939,284	13,641,198
2025	98	4.9569	3,516,350	761,507	10,605,047
2026	90	5.1951	3,390,549	581,376	7,524,630
2027	83	5.4429	3,268,094	398,535	4,393,623
2028	77	5.7007	3,149,008	212,603	1,205,297

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 4 percent compound
Interest earnings: 6 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$71,600,000**

adjustment factor from the interest rate) are included in table 12.

The diagonal elements indicate the effect of larger adjustment factors, holding the real interest rate at 2 percent. As the annual adjustment factor increases, the required assessment increases but at a decreasing rate. If the annual adjustment factor increases from 4 to 5 percent, the prefunding level rises by over 15 percent (from $71.6 million to $82.7 million). But increasing the annual adjustment factor from 7 to 8 percent only raises the forward funding required by 7 percent (from $100.3 million to $107.3 million). On the average, over the range of adjustment factors listed in table 12, one percentage point more in the annual adjustment factor leads to a 10 percent increase in the necessary forward funding level for the benefit adjustment plan.

Table 12 also demonstrates the sensitivity of the required funding level to the real interest rate. Holding the adjustment factor constant at 5 percent, the necessary forward funding level increases from $70.3 million at 8 percent interest (3 percent real interest rate) to $82.7 million at 7 percent interest, and to $98.5 million at 6 percent interest (1 percent real interest rate). Similar sensitivity is shown for the 6 percent benefit adjustment plan. On the average, a decline in the real interest rate of one percentage point leads to nearly a 17 percent increase in the required forward funding level. Thus the benefit adjustment fund is shown to be more sensitive to the earned interest rate than to the adjustment factor.

Nevertheless, the import of table 12 is that it demonstrates the sensitivity to both of these critical parameters. Furthermore, while one can be fairly confident that we have covered the likely range of the *average* values of these parameters for the next 50 years, we have not necessarily captured the possibilities in year-to-year variation. For instance, suppose the benefit adjustment fund was started in a time of rapid in-

Table 12
Forward Funding Required for Benefit Adjustment Plan*
Various Adjustment Factors and Interest Rates
1978 Injury Cohort

Interest Earnings Rate (percent)	Annual Adjustment Factor				
	4 percent	5 percent	6 percent	7 percent	8 percent
6	$71.6 (21.4%)	$98.5 (29.4%)			
7	$60.5 (18.1%)	$82.7 (24.7%)	$109.2 (32.6%)		
8		$70.3 (21.0%)	$92.2 (27.5%)	$118.4 (35.4%)	
9			$78.6 (23.5%)	$100.3 (30.0%)	$126.1 (37.7%)
10				$85.9 (25.7%)	$107.3 (32.1%)

*Dollar amounts are in millions of dollars. The figures in parentheses indicate the assessment rate on 1978 indemnity payments that would raise the required funds.

flation by historic standards (such as the present). Then one could expect both interest earnings of the fund and annual adjustment factors to be high in the early years. But because interest earnings exceed adjustment costs for many years in all the plans simulated above, the result will be higher year-end balances for the fund in these early years. When inflation subsided, the fund would face the future with larger "reserves" than were originally anticipated. Thus, even though the link between interest rates and adjustment factors was maintained, the "twist" in the impact of these parameters would benefit the fund. Of course, the opposite circumstance would have contrary consequences.

Last, it is necessary to discuss the range of estimated forward funding levels required for benefit adjustment plans under various assumptions as shown in table 12. There is more than 100 percent variation from the lowest to the highest estimate presented there. It would be difficult to cope with this range as one sets about to establish the assessment rate to actually fund a benefit adjustment plan. But all the options of table 12 are not equally likely. If we assume the real rate of interest will be 2 percent and discount the 4 percent and 8 percent annual adjustment factor variants, we are left with a much more manageable range. The low estimate, with a 5 percent annual adjustment factor and 7 percent fund interest earnings assumption, could be prefunded for $82.7 million or about 25 percent of 1978 indemnity payments. The high estimate, assuming the 7 percent annual adjustment factor and 9 percent interest earnings, would require $100.3 million or 30 percent of 1978 indemnity.

Thus it would appear fairly likely that the required assessment level will fall below 30 percent of base year indemnity. If it were thought desirable to avoid any substantial risk of underassessment, the assessment rate could be set at one-third of base year indemnity. This would result in a net cost impact, taking medical expenses into account, of one-fourth of current workers' compensation benefit costs.

While a 25 to 30 percent estimated assessment range is much more satisfactory for policy purposes, there is still a range of indeterminacy here. There is some unknown probability that an assessment of 30 percent of 1978 indemnity payments would not be sufficient to make lifetime inflation adjustment payments to the 1978 injury cohort. There is no way around this dilemma when focusing on a single cohort. With multiple cohorts in a fund, it may not be quite so troublesome since there would be more opportunity to adjust to the situation as it develops.[1]

1. Recall the discussion in chapter 3 about commingling funds from different cohorts.

Leaving aside the issue of sensitivity to the adjustment factor, let us go on to consider the sensitivity of the forward funding level of a benefit adjustment plan to the number of cases to be adjusted. This amounts to a sensitivity analysis of the retention function.

Sensitivity to the Number of Cases

The last major external item that will bear heavily on the benefit adjustment fund is the number of cases to be adjusted. Note that we have now come full circle, having begun with the question of how many cases would need to be adjusted. A retention function was derived from past workers' compensation data and that retention function was used as the basis for simulating the operation of a benefit adjustment fund. Now we return to ask: How sensitive are the forward funding levels of such a plan to the number of cases to be adjusted? What if the retention function significantly misses the mark?

To begin with, the prefunding level will vary proportionally with the number of cases. The forward funding required is nothing more than the present value of the stream of annual benefit adjustment payments into the future. Each year's benefit adjustment cost is in turn the product of the adjustment factor for that year, the basic unadjusted compensation rate, and the number of cases to be adjusted. But if the number of cases to be adjusted changes while the other factors do not, the annual adjustment cost in each year will change in precisely the same way as the number of cases.

Suppose that the pattern of case closure represented in the retention function developed earlier was correct, but that the actual number of cases is underestimated by 10 percent in each year. Then the adjustment costs in each future year will be 10 percent higher than estimated earlier, and the present value of the whole stream of annual adjustment costs will also be 10 percent higher. Thus, the estimated forward funding level will be 10 percent below the true required level.

Table 13 shows what would happen to the $82.7 million assessment estimated for the 5 percent annual adjustment factor plan (table 6) if the actual number of cases active turned out to be 10 percent higher than projected in each year. Since benefit adjustment costs would be 10 percent higher in each year, the balance of the fund would decline more rapidly and interest earnings would fall more quickly as well. The net result is that the benefit adjustment fund would be able to pay annual inflation supplements to the 1978 injury cohort only for 33 years. To prefund the entire 50 years (i.e., lifetime benefits) would require an additional $8.3 million (10 percent of the $82.7 million) in 1978 dollars, or a total of $91.0 million. Of course, the opposite would be true if the number of cases to be adjusted was 10 percent lower than projected.

While the forward funding level for a benefit adjustment plan responds proportionally to a uniform change in the number of active cases, this is probably not the most likely distortion of reality contained in the fund simulations. It would seem more probable, given the limited empirical evidence upon which it is built, that the retention function will prove to be inaccurate in representing the case closure pattern. We will examine two additional retention function specifications, one pessimistic and one optimistic.

Table 14 shows the fund simulation with a "pessimistic" retention function for the 1978 injury cohort. The change here from the 5 percent adjustment factor simulation of table 6 is that the last step down in the retention rate has been eliminated. Recall that it was hypothesized that after 20 years the closure rate would rise from 4 percent to 8 percent per year as a rising death rate overtook the aging beneficiary

Table 13
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,894,500	$ 85,594,500
1980	3,104	.0247	553,174	5,981,160	90,978,231
1981	2,638	.0759	1,445,717	6,341,152	95,758,010
1982	2,243	.1297	2,099,510	6,663,380	100,153,918
1983	2,063	.1862	2,772,597	6,958,372	104,117,886
1984	1,898	.2455	3,363,242	7,224,687	107,710,271
1985	1,822	.3078	4,047,664	7,463,218	110,802,012
1986	1,749	.3732	4,711,262	7,667,098	113,380,947
1987	1,679	.4418	5,254,919	7,835,458	115,433,093
1988	1,612	.5139	5,979,487	7,967,304	116,942,552
1989	1,548	.5896	6,585,782	8,061,507	117,891,414
1990	1,486	.6691	7,174,589	8,116,799	118,259,657
1991	1,426	.7526	7,746,662	8,131,764	118,025,026
1992	1,369	.8402	8,302,725	8,104,830	117,162,913
1993	1,315	.9322	8,843,472	8,034,262	115,646,226
1994	1,262	1.0288	9,369,572	7,918,150	113,445,238
1995	1,211	1.1303	9,881,668	7,754,403	110,527,441
1996	1,163	1.2368	10,380,374	7,540,732	106,857,369
1997	1,117	1.3486	10,866,284	7,274,644	102,396,426
1998	1,027	1.4661	10,867,467	6,962,356	97,621,915
1999	945	1.5894	10,838,960	6,628,678	92,544,516
2000	869	1.7188	10,784,143	6,274,296	87,171,938
2001	800	1.8548	10,706,093	5,899,691	81,509,048
2002	736	1.9975	10,607,608	5,505,160	75,557,981
2003	677	2.1474	10,491,229	5,090,774	69,318,228
2004	623	2.3047	10,359,266	4,656,486	62,786,707
2005	573	2.4700	10,213,809	4,202,028	55,957,821
2006	527	2.6435	10,056,758	3,726,975	48,823,497
2007	485	2.8257	9,889,829	3,230,727	41,373,209
2008	446	3.0169	9,714,575	2,712,519	33,593,987
2009	411	3.2178	9,532,400	2,171,417	25,470,411
2010	378	3.4287	9,344,570	1,606,316	16,984,592
2011	347	3.6501	9,152,224	1,015,944	8,116,135
2012	320	3.8826	8,956,388	398,854	0

Table 14
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$ 3,615,500	$106,915,500
1980	2,822	.0247	502,918	7,474,580	113,846,928
1981	2,399	.0759	1,314,373	7,944,443	120,371,848
1982	2,039	.1297	1,908,768	8,389,954	126,700,332
1983	1,876	.1862	2,520,705	8,821,382	132,799,353
1984	1,726	.2455	3,057,690	9,238,164	138,735,212
1985	1,657	.3078	3,679,932	9,641,914	144,402,800
1986	1,590	.3732	4,283,241	10,027,243	149,804,142
1987	1,527	.4418	4,868,422	10,394,277	154,940,524
1988	1,466	.5139	5,436,247	10,743,092	159,812,468
1989	1,407	.5896	5,987,460	11,073,710	164,419,720
1990	1,351	.6691	6,522,774	11,386,100	168,761,224
1991	1,297	.7526	7,042,874	11,680,175	172,835,096
1992	1,245	.8402	7,548,418	11,955,792	176,638,596
1993	1,195	.9322	8,040,038	12,212,745	180,168,100
1994	1,147	1.0288	8,518,342	12,450,770	183,419,061
1995	1,101	1.1303	8,983,913	12,669,538	186,385,973
1996	1,057	1.2368	9,437,311	12,868,653	189,062,330
1997	1,015	1.3486	9,879,076	13,047,649	191,440,576
1998	974	1.4661	10,309,724	13,205,987	193,512,060
1999	935	1.5894	10,729,753	13,343,052	195,266,979
2000	898	1.7188	11,139,640	13,458,149	196,694,317
2001	862	1.8548	11,539,844	13,550,499	197,781,785
2002	828	1.9975	11,930,806	13,619,233	198,515,748
2003	795	2.1474	12,312,950	13,663,388	198,881,149
2004	763	2.3047	12,686,683	13,681,902	198,861,433
2005	732	2.4700	13,052,397	13,673,610	198,438,454
2006	703	2.6435	13,410,468	13,637,234	197,592,382
2007	675	2.8257	13,761,258	13,571,379	196,301,603
2008	648	3.0169	14,105,113	13,474,526	194,542,606
2009	622	3.2178	14,442,369	13,345,022	192,289,869
2010	597	3.4287	14,773,346	13,181,075	189,515,729
2011	573	3.6501	15,098,354	12,980,742	186,190,249
2012	550	3.8826	15,417,688	12,741,923	182,281,069
2013	528	4.1267	15,731,636	12,462,347	177,753,249
2014	507	4.3831	16,040,471	12,139,563	172,569,103
2015	487	4.6522	16,344,457	11,770,927	166,688,016
2016	467	4.9348	16,643,849	11,353,592	160,066,252
2017	449	5.2316	16,938,890	10,884,493	152,656,744
2018	431	5.5432	17,229,816	10,360,329	144,408,871
2029	413	5.8703	17,516,853	9,777,552	135,268,222
2020	397	6.2138	17,800,218	9,132,351	125,176,338
2021	381	6.5745	18,080,121	8,420,629	114,070,437
2022	366	6.9533	18,356,763	7,637,988	101,883,121
2023	351	7.3509	18,630,338	6,779,705	88,542,061
2024	337	7.7685	18,901,033	5,840,715	73,969,660
2025	324	8.2069	19,169,028	4,815,582	58,082,691
2026	311	8.6672	19,434,494	3,698,476	40,791,914
2027	298	9.1506	19,697,601	2,483,149	22,001,655
2028	286	9.6581	19,958,506	1,162,900	1,609,368

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 5 percent compound
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$103,300,000**

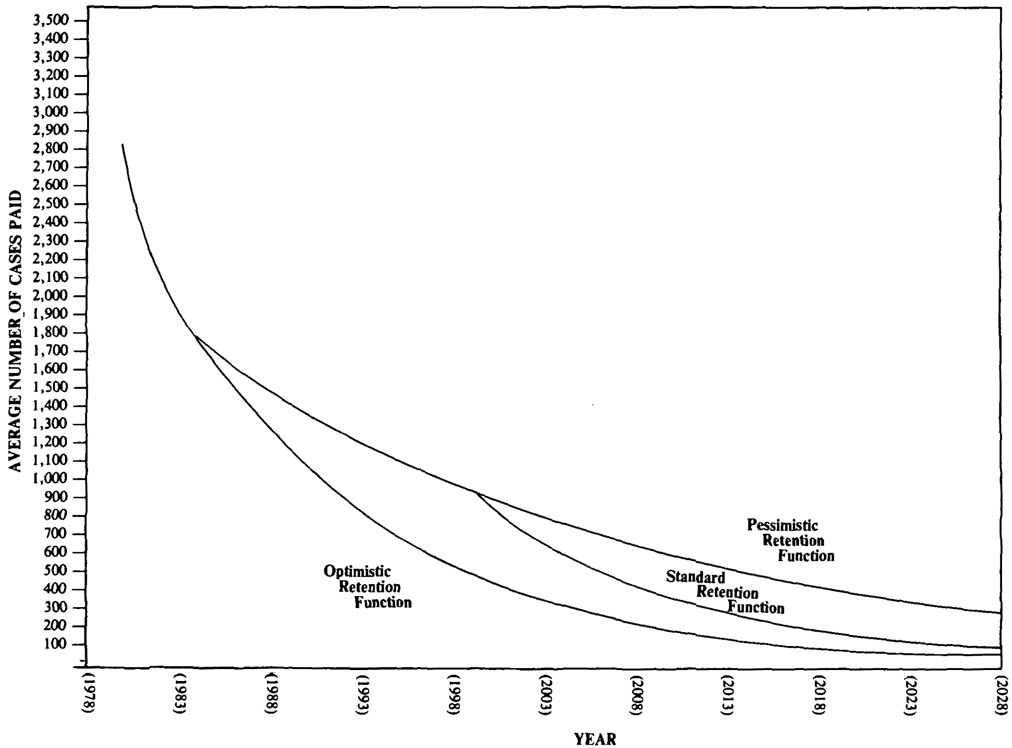
population. Table 14 does not include this step; the active case population declines uniformly by 4 percent per year commencing five years after the injury year. Thus, the distribution has a much "thicker" tail than previously contemplated. For instance, in year 2010 the plan of table 14 anticipates adjusting 597 cases while that of table 6 only projected 343. By year 2014, this pessimistic retention function produces twice as many, and by 2023 three times as many, cases to adjust; annual adjustment costs in those years vary proportionally as well.

Figure 2 shows the average number of cases to be adjusted in each future year according to these alternative retention functions. The elimination of the shift in the retention rate 20 years after the injury is quite obvious. The pessimistic retention function yields an average duration of disability for cases that enter adjustment status (i.e., have a minimum duration of two years) of 17.5 years. This compares to the average duration of 15.2 years for the standard retention function introduced in chapter 2.

Table 14 reveals that the more substantial tail on the duration distribution has a marked effect on the forward funding level. All other parameters are the same as in table 6, but $103.3 million is required to prefund the plan under the influence of this pessimistic retention function. This funding level is $20.6 million or nearly 25 percent greater than that of the basic plan presented in table 6. The major difference is that the annual adjustment costs continue to grow indefinitely in table 14; they do not reach a peak and then decline as they did earlier. The case closure rate here is always less than the increase in the adjustment factor for still active cases. Thus, expenditures never level off but continue to grow throughout the 50 years of the simulation.

The realism of this simulation with a pessimistic retention function will be left to the reader to judge. It would be

Figure 2
Standard, Optimistic and Pessimistic Retention Functions



astonishing, however, if fully 10 percent of the 1978 injury cases active during 1980 were still active 48 years later, as indicated under the retention function of table 14. The simulation of table 14 seems a relatively safe upper bound on benefit adjustment costs for a 5 percent plan.

In contrast, table 15 presents the results of a benefit adjustment fund simulation with an "optimistic" retention function. In this instance, the case closure rate is assumed never to fall below 8 percent per year; thus the retention rate rises to 92 percent in year four and remains constant thereafter. The result is a "thinner" tail to the case duration distribution. In year 2010 the optimistic retention function hypothesizes that only 197 cases will be active from the 1978 cohort whereas table 6 showed 343. By the end of the 50-year simulation, 44 cases remain active as opposed to 77 in the earlier simulation. Again, figure 2 gives a graphical demonstration of the results of this change in retention function specification. The average duration of disability with the optimistic retention function declines to 12.2 years.

The optimistic retention function produces annual costs of adjustment that peak at less than $5.7 million in 1998 and then decline slowly. Again, it is important to reiterate that only the retention function is altered from the 5 percent annual adjustment plan presented in table 6. With this optimistic retention function, the prefunding level required for the 5 percent plan is $57.9 million, or 30 percent less than for table 6. This can be regarded as a lower bound estimate for the 5 percent plan, holding other parameters constant.

Thus, the forward funding level of a benefit adjustment plan is revealed to be very sensitive to the specific shape of the retention function. This reflects the very large adjustment factors to be paid far in the future, which make each additional case very expensive. In comparison to the standard 5 percent adjustment plan of table 6 which required an

Table 15
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,026,500	$59,926,500
1980	2,822	.0247	502,918	4,185,350	63,568,698
1981	2,399	.0759	1,314,373	4,424,967	66,574,142
1982	2,039	.1297	1,908,768	4,624,114	69,136,787
1983	1,876	.1862	2,520,705	4,791,934	71,206,359
1984	1,726	.2455	3,057,690	4,926,655	72,830,709
1985	1,588	.3078	3,526,601	5,031,497	74,053,476
1986	1,461	.3732	3,933,740	5,109,396	74,914,432
1987	1,344	.4418	4,284,873	5,163,026	75,449,795
1988	1,236	.5139	4,585,277	5,194,824	75,692,520
1989	1,137	.5896	4,839,780	5,207,005	75,672,562
1990	1,046	.6691	5,052,798	5,201,581	75,417,122
1991	963	.7526	5,228,367	5,180,382	74,950,868
1992	886	.8402	5,370,178	5,145,064	74,296,140
1993	815	.9322	5,481,601	5,097,128	73,473,138
1994	750	1.0288	5,565,716	5,037,928	72,500,092
1995	690	1.1303	5,625,331	4,968,688	71,393,423
1996	634	1.2368	5,663,011	4,890,509	70,167,879
1997	584	1.3486	5,681,095	4,804,379	68,836,675
1998	537	1.4661	5,681,714	4,711,183	67,411,607
1999	494	1.5894	5,666,810	4,611,710	65,903,162
2000	455	1.7188	5,638,150	4,506,660	64,320,620
2001	418	1.8548	5,597,344	4,396,654	62,672,142
2002	385	1.9975	5,545,855	4,282,233	60,964,852
2003	354	2.1474	5,485,010	4,163,873	59,204,915
2004	326	2.3047	5,416,017	4,041,981	57,397,598
2005	300	2.4700	5,339,969	3,916,906	55,547,337
2006	276	2.6435	5,257,860	3,788,940	53,657,789
2007	254	2.8257	5,170,586	3,658,321	51,731,876
2008	233	3.0169	5,078,961	3,525,239	49,771,838
2009	215	3.2178	4,983,716	3,389,836	47,779,261
2010	197	3.4287	4,885,515	3,252,212	45,755,117
2011	182	3.6501	4,784,953	3,112,423	43,699,791
2012	167	3.8826	4,682,566	2,970,485	41,613,104
2013	154	4.1267	4,578,836	2,826,377	39,494,338
2014	141	4.3831	4,474,195	2,680,041	37,342,249
2015	130	4.6522	4,369,029	2,531,383	35,155,080
2016	120	4.9348	4,263,682	2,380,272	32,930,576
2017	110	5.2316	4,158,460	2,226,545	30,665,984
2018	101	5.5432	4,053,637	2,070,005	28,358,062
2019	93	5.8703	3,949,452	1,910,420	26,003,073
2020	86	6.2138	3,846,119	1,747,523	23,596,788
2021	79	6.5745	3,743,823	1,581,017	21,134,476
2022	73	6.9533	3,642,728	1,410,566	18,610,896
2023	67	7.3509	3,542,974	1,235,800	16,020,285
2024	61	7.7685	3,444,683	1,056,315	13,356,342
2025	57	8.2069	3,347,961	871,667	10,612,211
2026	52	8.6672	3,252,896	681,375	7,780,458
2027	48	9.1506	3,159,562	484,916	4,853,048
2028	44	9.6581	3,068,020	281,728	1,821,314

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 5 percent compound
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$57,900,000**

assessment rate of nearly 25 percent, the pessimistic retention function requires nearly 31 percent and the optimistic retention function 17 percent of 1978 indemnity payments to prefund lifetime benefit adjustment payments for the 1978 injury cohort. This range of variation is not unlike that shown in table 12 for sensitivity to the inflation parameters.

This analysis could also be interpreted as measuring the sensitivity of the prefunding requirement to utilization levels. Suppose the original retention function correctly describes the current duration distribution among workers' compensation cases in Michigan. Then the pessimistic retention function could be thought of as the emerging pattern if the existence of a benefit adjustment fund serves to reduce the likelihood of closure among the long term disability cases. In these terms, the sensitivity analysis of the retention function is somewhat reassuring. When the extreme long term closure rate was cut in half (from 8 percent to 4 percent annually), the forward funding level increased by about one-fourth (from $82.7 million to $103.3 million). This is a very significant change, but it does not suggest an unstable response to the number of cases to be adjusted in the distant future.

Nevertheless, it is not possible to leave the discussion of the retention function without a final caution. The retention function is the critical behavioral component of the cost model employed here. But it was constructed from very sparse empirical evidence and its validity is essentially untested. This is particularly critical for the extremely long durations. These have not even been observed yet in Michigan due to the limited time since lifetime benefits were established. The sensitivity analysis presented here has probed this area, but it is not an adequate substitute for actual experience. If a benefit adjustment fund is to be implemented, a very high priority must be placed on a data system that will generate sufficient case duration information, both to track what is happening currently and to improve the prediction of what will develop in the future.

The conclusions of this sensitivity analysis would appear to be threefold. First, it appears that a benefit adjustment fund for one cohort of workers' compensation beneficiaries in Michigan can be adequately prefunded, including some provision for unforeseen contingencies, with an assessment level of about 30 to 33 percent of base year indemnity payments. Such an assessment on the example 1978 injury cohort would yield between $100 million and $110 million. This would amount to a benefit cost increase of between 22 and 25 percent of the $335 million in total 1978 indemnity payments for the Michigan workers' compensation system. The insured sector's share of this amount, some $60 to $66 million, would constitute a cost increase of 7.5 to 8.2 percent of the Standard Earned Premium for 1978.

Second, the single cohort forward funding level is very sensitive to the annual adjustment factor, the interest earnings rate, and the number of cases to be adjusted. These are the major ways in which actual future developments will impinge on the fund, and policy control of these parameters is not possible. However, while the funding level is sensitive to these elements, it is not unstable or explosive in response. It appears to change in a relatively smooth and predictable manner with changes in these parameters.

Third, there will inevitably be some level of risk associated with establishing a prefunded benefit adjustment plan. It is not possible to foresee the costs of such an operation with perfect clarity. Thus, the choice of an assessment level will carry with it an unspecified probability of insufficiency. The data system that would be needed to accompany the fund will make possible the detection of the insufficiency. The commingling of funds from different cohorts, discussed in the last chapter, combined with the regularity of fund response that emerges from the sensitivity analysis, will make possible the adaptation to any insufficiency. But the risk of insufficiency cannot be avoided at reasonable assessment levels when prefunding lifetime benefit adjustment payments for a single injury cohort.

In the next chapter a number of possible modifications in the plan are considered, all of which would have the effect of reducing the current cost of benefit adjustment. None of them can fundamentally alter the necessity to face the uncertainties inherent in this situation, however.

CHAPTER 5
Reducing the Cost of Benefit Adjustment

Based on the experience of the Workers' Compensation Reform Task Force in Michigan, the major impediment to implementing an inflation adjustment plan is clearly the cost. As we have seen here, the estimated cost of such a program is quite high. But there is also the fear that even these estimates will prove too low due to increased utilization, future inflation rates, or whatever.

The sensitivity analysis of the last chapter examined the way in which the forward funding level varies with the critical parameters of benefit adjustment that will be imposed by the outside world. Knowledge of the potential impact of future developments is one sort of adaptation to the uncertainty that exists in this situation. But it is also worth looking at the specifics of the benefit adjustment plan itself to determine whether there are ways in which the uncertainty could be reduced or costs lowered. This will be done in the first part of the chapter.

Later on we will look at a current funding, or "pay-as-you-go," approach to benefit adjustment. Naturally, this would bring annual costs down dramatically in the near future; it would also produce huge unfunded liabilities, however. Last, growing out of the discussion of the current funding approach, an intermediate, adaptive strategy is reviewed. This would amount to a pay-as-you-go approach with fairly substantial reserves (far short of those in a prefunded plan, however). The adaptive element would derive from the middle term focus (10 to 20 years) of the plan's management.

Fund Alternatives

There are a number of ways that a benefit adjustment plan could be made less expensive, even in the uncertain world in which it will operate. Obviously, this does not simply amount to choosing one of the "cheaper" states of the world that have been reviewed in the sensitivity analysis, but the same effects can be generated by manipulating the structure of the plan.

For instance, we saw in chapter 4 that the cost of a benefit adjustment plan depends rather heavily on the annual adjustment factors that will be paid. While it is not possible to affect the rate of increase in the state average weekly wage, it is possible to include only a fraction of this change in the adjustment factor. This could be done either through specifying that the adjustment factor will be some particular fraction, say two-thirds or three-fourths, of the increase in the state average weekly wage, or through the use of annual caps. That is, it could be specified that the adjustment factor will be the increase in the state average weekly wage but not to exceed 6 percent, or 8 percent, or some other number, per year.

To the extent that the cap would reduce the average annual adjustment factor over a period of years, the cost of the plan would be reduced correspondingly. This technique would also have the effect of reducing the uncertainty inherent in prefunding the plan, since there would be no question of the average adjustment factor exceeding the annual cap. It would give rise to some equity concerns, however. In times like the present when those still working are experiencing declining real incomes as average wage increases lag behind price increases, there would appear to be little justification beyond expediency for forcing the disabled to tighten their belts more than their former colleagues. However, the cost savings could be very significant (recall table 12 in chapter 4) and the use of annual caps on the adjustment factor would also have the effect of increasing the spread between the fund interest earnings rate and the annual adjustment factor, to the benefit of the financial health of the fund.

Another suggestion has been to impose a lifetime maximum adjusted benefit level of 200 percent of the original benefit. The simulation of this plan is presented in table 16. The cost side of this simulation is identical to that of table 6 until the lifetime maximum is reached in 1994, some 16 years after the year of the injury. Then the average adjustment factor stops rising and adjustment costs decline with the number of cases. The projected assessment level necessary to prefund this plan for the 1978 injury cohort is $60.7 million, or an assessment rate of 18.1 percent on 1978 indemnity payments. This is a reduction of more than one-fourth from the assessment level of table 6.

A plan with a maximum lifetime benefit is not necessarily very attractive as a permanent solution to the inflation protection needs of workers' compensation beneficiaries, but it does have a substantial cost impact. Given the vast uncertainties of these future projections, perhaps the idea of a lifetime maximum would have some appeal as another adaptive technique. Using the best assumptions available about the future at the present time, we estimate the forward funding required for a benefit adjustment plan with a lifetime maximum. The assessment rate is determined, assessments collected, and the fund goes into operation. Now there are three major potential sources of variation in the actual fund performance. First, fund earnings may differ from projected

Table 16
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,124,500	$62,824,500
1980	2,822	.0247	502,918	4,388,210	66,669,558
1981	2,399	.0759	1,314,373	4,642,027	69,892,063
1982	2,039	.1297	1,908,768	4,856,369	72,686,962
1983	1,876	.1862	2,520,705	5,040,446	75,005,046
1984	1,726	.2455	3,057,690	5,192,563	76,895,304
1985	1,657	.3078	3,679,932	5,313,121	78,234,098
1986	1,590	.3732	4,283,241	5,395,434	79,003,631
1987	1,527	.4418	4,868,422	5,438,241	79,183,977
1988	1,466	.5139	5,436,247	5,440,133	78,752,963
1989	1,407	.5896	5,987,460	5,399,544	77,686,050
1990	1,351	.6691	6,522,774	5,314,743	75,956,197
1991	1,297	.7526	7,042,874	5,183,823	73,533,716
1992	1,245	.8402	7,548,418	5,004,695	70,386,120
1993	1,195	.9322	8,040,038	4,775,072	66,477,950
1994	1,147	1.0000	8,279,671	4,496,971	62,032,877
1995	1,101	1.0000	7,948,484	4,192,075	57,640,589
1996	1,057	1.0000	7,630,545	3,890,624	53,290,225
1997	1,015	1.0000	7,325,323	3,591,867	48,970,743
1998	934	1.0000	6,739,297	3,300,579	44,992,882
1999	859	1.0000	6,200,153	3,032,319	41,329,035
2000	790	1.0000	5,704,141	2,785,224	37,953,787
2001	727	1.0000	5,247,810	2,557,581	34,843,734
2002	669	1.0000	4,827,985	2,347,812	31,977,322
2003	615	1.0000	4,441,746	2,154,464	29,334,700
2004	566	1.0000	4,086,406	1,976,196	26,897,577
2005	521	1.0000	3,759,494	1,811,776	24,649,099
2006	479	1.0000	3,458,734	1,660,067	22,573,733
2007	441	1.0000	3,182,036	1,520,021	20,657,155
2008	406	1.0000	2,927,473	1,390,672	18,886,156
2009	373	1.0000	2,693,275	1,271,128	17,248,548
2010	343	1.0000	2,477,813	1,160,568	15,733,077
2011	316	1.0000	2,279,588	1,058,231	14,329,353
2012	291	1.0000	2,097,221	963,417	13,027,772
2013	267	1.0000	1,929,443	875,478	11,819,451
2014	246	1.0000	1,775,088	793,812	10,696,168
2015	226	1.0000	1,633,081	717,867	9,650,308
2016	208	1.0000	1,502,434	647,126	8,674,804
2017	192	1.0000	1,382,240	581,112	7,763,098
2018	176	1.0000	1,271,660	519,382	6,909,087
2019	162	1.0000	1,169,928	461,524	6,107,089
2020	149	1.0000	1,076,333	407,154	5,351,803
2021	137	1.0000	990,227	355,911	4,638,269
2022	126	1.0000	911,009	307,461	3,961,841
2023	116	1.0000	838,128	261,488	3,318,151
2024	107	1.0000	771,078	217,697	2,703,084
2025	98	1.0000	709,391	175,808	2,112,750
2026	90	1.0000	652,640	135,558	1,543,456
2027	83	1.0000	600,429	96,694	991,686
2028	77	1.0000	552,395	58,978	454,078

Fund Parameters
Waiting period: 2 years
Payments begin: Anniversary date
Annual adjustment rate: 5 percent compound
Maximum adjusted benefit level: 200 percent
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$60,700,000**

levels. This would be particularly likely in early years (where it would have the greatest impact), assuming that interest rates and inflation rates would be declining over the next few years. Yet, if the annual adjustment factor was capped, the increase in fund earnings would not be entirely offset by greater adjustment payments. Thus the financial condition of the fund should improve, perhaps sufficiently to make possible a modification of the lifetime maximum.

Second, it is likely that the retention function will turn out to be too cautious and the magnitude of long term cases will be significantly lower than predicted. This, of course, would free funds for adjusting the cases that do remain active, possibly enabling a revocation of the lifetime maximum provision. Third, it may turn out that the plan will face a less inflationary world than anticipated. Hopefully, inflation rates will drop significantly, and the magnitude of the burden on the benefit adjustment fund will be reduced accordingly. Once again, this would free funds already collected that could be used for future adjustments above the lifetime maximum.

In the event that none of these things came to pass, it would still be many years before a claimant suffered any loss through the 200 percent lifetime maximum provision. Thus there would be time to anticipate this situation and make whatever provisions would be necessary to protect the integrity of the claimants' compensation benefits. We would also be in a far superior position to predict the actual costs after some years of operation of a benefit adjustment fund. The data would be better and we would have a better understanding of the behavioral changes induced by system changes. Thus a decision on revoking the lifetime maximum could be made in a less uncertain environment.

A definitional issue that would impact on the adjustment factor is the basis for figuring length of disability. One suggestion has been that *continuous* years of disability, with appropriate provision for work experiments, would be the basis for qualifying and for calculating the adjustment factor for an individual case. Another suggestion has been that *cumulative* years of disability would be preferable. This issue has considerable importance in cases that show multiple spells of disablement stemming from a single accident or disease and in repeated trauma cases. Would the adjustment factor be calculated from the original injury date, the most recent injury date, or from the last day of work? What impact would this have on the cost of adjustment?

In the active case tabulations underlying the simulations presented here, no actual measurement of duration of disability was made. Active cases were tabulated according to the injury date alone; this need not coincide with the date of onset of disability, of course.[1] Generally, this method should overestimate the actual duration of disability, but without more detailed study of durations it is not possible to determine the cost impact of various administrative definitions of the date of injury or the duration of disability. However, it is clear that a method that results in shorter average durations will lower the cost of benefit adjustment.

Another way to reduce the cost of benefit adjustment would be to reduce the number of cases to be adjusted. This might be done through disqualifying certain groups of cases, partial disabilities for example. Under current law in Michigan, partial disability compensation cases are essential-

1. Michigan statute provides (Section 301(1)):

> Time of injury or date of injury as used in this act in the case of a disease or in the case of an injury not attributable to a single event shall be the last day of work in the employment in which the employee was last subjected to the conditions resulting in disability or death.

Thus in many of the cases where there would be some question as to whether the date of injury and date of disablement are the same, the statute already provides an "artificial" injury date. This will reduce the impact of the issues raised here, but not eliminate them entirely.

ly self-liquidating. Since the basis of compensation is two-thirds of the difference between the pre-injury earnings and current earnings, it does not take long for the inflationary rise in current earnings to eliminate the basis for indemnity payments. But if these cases are not characterized by total dependence on the income maintenance element of workers' compensation, perhaps an argument could be made for a flat exclusion from benefit adjustment. Similar thoughts have been expressed in Michigan with regard to scheduled losses.

In a more positive vein, the number of cases to be adjusted could also be reduced by more aggressive rehabilitation efforts. In a larger policy context, this could be regarded as an important social benefit. Full lifetime benefit adjustment will make long duration cases significantly more expensive and raise the direct economic payoff to rehabilitation. Increased rehabilitative efforts can in turn be expected to reduce the number of cases requiring benefit adjustment.

The expense of benefit adjustment can also be affected by the waiting period before adjustment begins. In all simulations presented heretofore, benefit adjustment began on the second anniversary of the injury. But if it was determined that this plan is simply too expensive, one adaptation that could be made would be to increase the waiting period. Table 17 shows the results of a simulation on the 1978 injury cohort of a benefit adjustment plan with a three-year waiting period. All other parameters are the same as in table 6.

The forward funding level for this plan is $72.4 million, about 12.5 percent less than for table 6. Adjustment costs are lower in every year because claimants are credited with one less year of longevity at each point in the 50-year simulation. Interest earnings are higher due to the additional year "head start" relative to adjustment costs. A reduction of one-eighth in funding level is very significant, but the paltry adjustment factor of 5 percent after three full years must be

Table 17
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,534,000	$ 74,934,000
1980	0	.0000	0	5,245,380	80,179,380
1981	2,399	.0247	427,534	5,604,476	85,322,119
1982	2,039	.0759	1,117,357	5,951,430	90,066,804
1983	1,876	.1297	1,756,286	6,271,482	94,441,498
1984	1,726	.1862	2,319,339	6,567,069	98,503,681
1985	1,657	.2455	2,935,749	6,839,772	102,172,844
1986	1,591	.3078	3,533,177	7,085,322	105,442,335
1987	1,527	.3732	4,112,426	7,303,239	108,304,154
1988	1,466	.4418	4,674,269	7,492,947	110,748,890
1989	1,407	.5139	5,219,450	7,653,775	112,765,659
1990	1,351	.5896	5,748,681	7,784,946	114,342,029
1991	1,297	.6691	6,262,646	7,885,578	115,463,949
1992	1,245	.7526	6,762,005	7,954,675	116,115,659
1993	1,195	.8402	7,247,388	7,991,120	116,279,601
1994	1,147	.9322	7,719,402	7,993,675	115,936,322
1995	1,102	1.0288	8,178,631	7,960,966	115,064,367
1996	1,057	1.1303	8,625,635	7,891,481	113,640,162
1997	1,015	1.2368	9,060,952	7,783,559	111,637,893
1998	934	1.3486	9,089,887	7,642,854	109,463,669
1999	859	1.4661	9,090,877	7,490,639	107,136,161
2000	791	1.5894	9,067,030	7,328,164	104,671,934
2001	727	1.7188	9,021,174	7,156,535	102,085,600
2002	669	1.8548	8,955,884	6,976,726	99,389,972
2003	616	1.9975	8,873,499	6,789,589	96,596,182
2004	566	2.1474	8,776,146	6,595,864	93,713,808
2005	521	2.3047	8,665,755	6,396,184	90,750,977
2006	479	2.4700	8,544,078	6,191,085	87,714,458
2007	441	2.6435	8,412,701	5,981,012	84,609,754
2008	406	2.8257	8,273,061	5,766,322	81,441,170
2009	373	3.0169	8,126,457	5,547,292	78,211,888
2010	343	3.2178	7,974,064	5,324,122	74,924,021
2011	316	3.4287	7,816,939	5,096,941	71,578,668
2012	291	3.6501	7,656,038	4,865,808	68,175,955
2013	267	3.8826	7,492,217	4,630,714	64,715,075
2014	246	4.1267	7,326,247	4,391,589	61,194,318
2015	226	4.3831	7,158,819	4,148,301	57,611,095
2016	208	4.6522	6,990,550	3,900,655	53,961,956
2017	192	4.9348	6,821,992	3,648,401	50,242,606
2018	176	5.2316	6,653,635	3,391,229	46,447,909
2019	162	5.5432	6,485,915	3,128,770	42,571,891
2020	149	5.8703	6,319,217	2,860,599	38,607,735
2021	137	6.2138	6,153,882	2,586,233	34,547,776
2022	126	6.5745	5,990,206	2,305,129	30,383,483
2023	116	6.9533	5,828,450	2,016,686	26,105,443
2024	107	7.3509	5,668,842	1,720,240	21,703,334
2025	98	7.7685	5,511,575	1,415,065	17,165,897
2026	90	8.2069	5,356,818	1,100,369	12,480,903
2027	83	8.6672	5,204,711	775,294	7,635,110
2028	77	9.1506	5,055,374	438,911	2,614,217

Fund Parameters
Waiting period: 3 years
Payments begin: Anniversary date
Annual adjustment rate: 5 percent compound
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$72,400,000**

weighed against this. This factor could be mitigated by a "catch-up" adjustment factor that would pick up a larger share of the change in the state average weekly wage since the injury, perhaps all of it, but then the cost savings would be slashed also.

Roughly speaking, the 12.5 percent savings over table 6 can be broken down into the additional 7 percent interest earnings and the 5 percent lower payments resulting from the extra waiting year. Restoring the 5 percent to the adjustment factor would reduce the cost savings correspondingly; then the only gain would be from the extra year of interest earned before adjustment payments begin. Whether it is worth it to make the claimants wait another year for their adjustments will be left to others to decide.

There is another more complicated possibility, first suggested by State Senator David Plawecki (D-Dearborn Heights). Senator Plawecki proposed that benefits be adjusted annually according to the rise in the state average weekly wage (with a 6 percent annual cap), but that *insurers* carry responsibility for the first five years of adjustment payments. An assessment similar to that described earlier would be levied against indemnity payments in each year, but now the benefit adjustment fund would operate with a five-year waiting period. Thus there would be five full years of interest earnings before adjustment payments begin, yet claimants would be protected from inflation during the interim.

Table 18 presents a simulation of this plan using a 5 percent adjustment factor for the 1978 injury cohort. Under the same procedures discussed earlier, it would be necessary to raise $64.1 million or 19.1 percent of 1978 indemnity, to prefund this plan. This is a reduction of $18.6 million (more than 22 percent) from the comparable plan in table 6. Exactly the same adjustment payments are being made, so after 50

Table 18
Benefit Adjustment Fund Simulation, 1978 Injury Cohort

Year	Average Cases Paid	Average Adjustment Factor	Cost of Adjustment	Interest Income	Year-end Balance
1979	0	.0000	$ 0	$2,243,500	$ 66,343,500
1980	0	.0000	0	4,644,045	70,987,545
1981	0	.0000	0	4,969,128	75,956,673
1982	0	.0000	0	5,316,967	81,273,640
1983	1,876	.0247	387,027	5,681,840	86,537,491
1984	1,726	.0759	1,094,791	6,036,933	91,392,050
1985	1,657	.1297	1,795,635	6,363,506	95,816,270
1986	1,591	.1862	2,474,403	6,660,373	99,804,287
1987	1,527	.2455	3,132,024	6,927,105	103,348,806
1988	1,466	.3078	3,769,394	7,163,175	106,441,035
1989	1,407	.3732	4,387,370	7,367,951	109,070,627
1990	1,351	.4418	4,986,777	7,540,694	111,225,602
1991	1,297	.5139	5,568,407	7,680,549	112,892,272
1992	1,245	.5896	6,133,020	7,786,545	114,055,156
1993	1,195	.6691	6,681,348	7,857,583	114,696,883
1994	1,147	.7526	7,214,092	7,892,436	114,798,100
1995	1,102	.8402	7,731,926	7,889,734	114,337,354
1996	1,057	.9322	8,235,497	7,847,964	113,290,981
1997	1,015	1.0288	8,725,429	7,765,458	111,632,975
1998	934	1.1303	8,818,889	7,647,631	109,756,207
1999	859	1.2368	8,877,960	7,515,141	107,683,150
2000	791	1.3486	8,906,311	7,369,491	105,433,826
2001	727	1.4661	8,907,281	7,212,020	103,025,983
2002	669	1.5894	8,883,916	7,043,913	100,475,267
2003	616	1.7188	8,838,986	6,866,212	97,795,374
2004	566	1.8548	8,775,014	6,679,828	94,998,187
2005	521	1.9975	8,694,293	6,485,551	92,093,902
2006	479	2.1474	8,598,906	6,284,054	89,091,138
2007	441	2.3047	8,490,745	6,075,905	85,997,038
2008	406	2.4700	8,371,525	5,861,571	82,817,362
2009	373	2.6435	8,242,801	5,641,426	79,556,564
2010	343	2.8257	8,105,981	5,415,756	76,217,861
2011	316	3.0169	7,962,338	5,184,762	72,803,297
2012	291	3.2178	7,813,023	4,948,565	69,313,798
2013	267	3.4287	7,659,071	4,707,209	65,749,210
2014	246	3.6501	7,501,419	4,460,668	62,108,345
2015	226	3.8826	7,340,907	4,208,841	58,389,007
2016	208	4.1267	7,178,288	3,951,561	54,588,016
2017	192	4.3831	7,014,242	3,688,592	50,701,227
2018	176	4.6522	6,849,371	3,419,633	46,723,539
2019	162	4.9348	6,684,217	3,144,316	42,648,901
2020	149	5.2316	6,519,261	2,862,209	38,470,308
2021	137	5.5432	6,354,928	2,572,813	34,179,799
2022	126	5.8703	6,191,597	2,275,565	29,768,440
2023	116	6.2138	6,029,600	1,969,831	25,266,303
2024	107	6.5745	5,869,230	1,654,913	20,542,448
2025	98	6.9533	5,710,741	1,330,038	15,704,886
2026	90	7.3509	5,554,356	994,365	10,700,546
2027	83	7.7685	5,400,265	646,973	5,515,232
2028	77	8.2069	5,248,633	286,867	133,576

Fund Parameters

Waiting period: 5 years (Insurer pays earlier supplements)
Payments begin: Anniversary date
Annual adjustment rate: 5 percent compound
Interest earnings: 7 percent of average balance
Administrative costs: 8 percent of payout

FORWARD FUNDING REQUIRED: **$64,100,000**

years have passed the total adjustment costs paid by the fund and the insurers will be identical to those in the plan represented by table 6. But the adjustment costs to be incurred by insurers do not appear in table 18. Still, this could be an attractive compromise funding alternative.

After the two-year waiting period, insurers will begin adjusting weekly compensation benefits. Under the simulation of table 18, they will advance the compensation rates of active cases by 5 percent on the second, third, and fourth anniversaries of the injury. These three years of adjustment will be built into the compensation structure and will be a permanent insurer obligation. Additional adjustments on this base would be the responsibility of the benefit adjustment fund, beginning on the fifth anniversary of the injury.

The insurer's burden can be determined by subtracting the cost of adjustment for each year in table 18 from the corresponding annual cost in table 6. On the basis of the 1978 injury cohort simulations, insurers would be liable for benefit adjustment payments totaling one-half million dollars in 1980, $1.3 million in 1981, $1.9 million in 1982, $2.1 million in 1983 and declining amounts thereafter as the number of cases declines with the retention function.

The effect of this pattern of adjustment would be to increase insurers' income maintenance benefit payments to 1978 cohort cases by 15.8 percent in each year after 1982.[2] In exchange for this stream of payments insurers as a whole could reduce the 1978 benefit adjustment fund assessment by $18.6 million. In other words, for annual payments of $2.1 million maximum, declining to less than one million dollars by year 2000, a substantial reduction in assessment level can be realized. What this amounts to, in fact, is placing a pro-

2. Of course this would be much less than a 15 percent increase in workers' compensation costs since it only involves cases with more than two years' disability and does not involve medical payments at all.

portion of the benefit adjustment burden on a "pay-as-you-go" basis. In the next section we will consider a benefit adjustment fund operated completely on a current funding basis.

While a number of the options considered here offer significant cost-saving potential, they mostly achieve this at the expense of some claimants. This does not necessarily make them unacceptable, since even a flawed benefit adjustment plan is better than no plan at all from the claimants' point of view. However, the implementation decisions will be difficult ones since they will involve questions of equity among claimants.

For instance, assuming it was necessary to reduce costs, would it be better to increase the waiting period before benefit adjustment begins or to impose an annual cap on the adjustment factor? This is not an easy question to answer, particularly in advance of any experience with the benefit adjustment population. Perhaps it is best that these choices will be made in the legislative arena, since they must be made with imperfect information and will involve important equity issues. Let us go on to consider a current funding approach to benefit adjustment, apparently the "cheapest" and most controversial approach of all.

Current Funding Basis

Due to the difficulties of the Social Security system in the last few years, "pay-as-you-go" has acquired a relatively unsavory connotation.[3] However, it is an option available to a public income maintenance program, and it certainly can reduce current payments in the short-run, although admittedly this is at the expense of future unfunded liabilities.

3. See the excellent book by Martha Derthick, *Policymaking for Social Security* (Washington, DC: Brookings Institution), 1979 for an account of the reasons for these difficulties.

While a current funded, or pay-as-you-go, strategy is regarded as unfair competition by the insurance industry since they cannot use this approach themselves, it still should be reviewed in the search for a viable inflation protection program. The Second Injury Fund and the other special funds in Michigan workers' compensation are now operating on a current funding basis, so the principle is not new. With careful design and prudent management of such a program, it may well be a viable strategy for an inflation protection plan for workers' compensation beneficiaries in Michigan and elsewhere.

The annual costs of a pay-as-you-go benefit adjustment program would be the same figures as were presented in the adjustment cost column of table 7 back in chapter 3 when the operation of the full fund was presented. They are repeated in table 19 together with the estimated number of cases that would be receiving adjustment payments in each year up to 2028. To repeat, these projections are based on an assumption of a 4 percent annual increase in the number of claims and a 5 percent increase in the average compensation rate. The retention function is applied to each cohort in exactly the way it was earlier. Thus, the number of cases to be adjusted changes each year in accord with the balance between the incoming cohort and the cumulative closure of older cases. Similarly, for the annual adjustment costs, the annual change is made up of the increase occasioned by the new cohort entering adjustment status, plus the additional year's adjustment step to older cases, less the previous cost of adjusting cases that have closed during the year.

Under the static assumptions used for the simulations presented in this paper, the annual rate of increase in the number of cases in adjustment status will slowly approach 4 percent as the case population matures through the 50-year time span. The annual rate of increase in adjustment costs will approach 9.2 percent, as this is the amount by which the

Table 19
Estimated Benefit Adjustment Costs, Current Funding Basis, 1980 - 2028

Year	Projected Case Load	Estimated Annual Adjustment Costs	Year	Projected Case Load	Estimated Annual Adjustment Costs
1980	2,822	$ 543,152	2005	64,267	$ 509,053,395
1981	5,334	2,012,669	2006	67,314	565,769,822
1982	7,586	4,259,284	2007	70,449	627,540,753
1983	9,765	7,373,353	2008	73,671	694,823,296
1984	11,881	11,353,768	2009	76,995	768,117,976
1985	14,013	16,372,310	2010	80,419	847,972,128
1986	16,162	22,503,960	2011	83,949	934,984,283
1987	18,336	29,831,544	2012	87,605	1,029,809,523
1988	20,535	38,446,546	2013	91,372	1,133,164,002
1989	22,763	48,449,387	2014	95,275	1,245,830,864
1990	25,023	59,950,556	2015	99,213	1,368,665,541
1991	27,325	73,071,891	2016	103,491	1,502,602,749
1992	29,663	87,946,918	2017	107,827	1,648,643,108
1993	32,044	104,721,993	2018	112,315	1,807,962,031
1994	34,475	123,557,534	2019	116,961	1,981,719,329
1995	36,956	144,629,482	2020	121,796	2,171,265,685
1996	39,493	168,130,455	2021	126,803	2,378,055,628
1997	42,088	194,270,957	2022	131,994	2,603,678,210
1998	44,707	222,817,856	2023	137,395	2,849,868,717
1999	47,354	253,963,569	2024	142,999	3,118,328,214
2000	50,040	287,921,588	2025	148,815	3,411,708,540
2001	52,768	324,927,597	2026	154,856	3,731,687,739
2002	55,552	365,242,138	2027	161,136	4,080,930,166
2003	58,389	409,152,587	2028	167,656	4,462,123,068
2004	61,292	456,974,317			

workers' compensation costs of each succeeding injury cohort exceeds the cost of the preceding one. After the very rapid early rise in the number of cases and the costs of adjustment, they both settle down to a steady rate of increase in accord with the assumptions. This result would apply precisely to an actual situation only if both the rate of increase in the number of claims and the rate of increase in the average compensation rate were constant. This would of course be a very unusual world. However, the point to be made is that the costs are not explosive. As the case population matures, the rate of increase in current funding levels required for benefit adjustment payments approaches the rate characterizing the underlying parameters of the workers' compensation case population.

This is demonstrated in table 20 which projects the cost of a current funded benefit adjustment program relative to the total indemnity base, i.e., the base against which the assessments would be levied. Starting from the actual total indemnity paid in 1978 of $334.8 million, each subsequent year is estimated to show an increase of 9.2 percent in total indemnity payments (in accord with assumptions presented in chapter 3). Then, as the annual rate of increase in pay-as-you-go benefit adjustment costs approaches the stable value of 9.2 percent, the relative cost stabilizes as well since both the required annual assessment amount and the assessment base are increasing at the same rate.

While this exercise is also artificial in being based on a steady state assumption, it does enable us to estimate the long-run relative cost level of a current funded benefit adjustment plan. The last column of table 20 represents the approximate assessment rate necessary to pay each year's total benefit adjustment costs. Under the assumptions employed here, annual adjustment costs will eventually rise to just over 16 percent of *then* current indemnity payments and hold there, so long as the underlying case dynamics remain the

Table 20
Relative Cost of Current Funded Benefit Adjustment Program

Year	Estimated Annual Adjustment Costs (millions)	Estimated Total Indemnity Base (millions)	Relative Cost
1978	$ 0	$ 334.8	0
1979	0	365.6	0
1980	0.5	399.2	.001
1981	2.0	435.9	.005
1982	4.3	476.1	.009
1983	7.4	519.8	.014
1984	11.4	567.9	.020
1985	16.4	619.9	.026
1986	22.5	676.9	.033
1987	29.8	739.2	.040
1988	38.4	807.2	.048
1989	48.4	881.5	.055
1990	60.0	962.6	.062
1991	73.1	1,051.1	.070
1992	87.9	1,147.8	.077
1993	104.7	1,253.4	.084
1994	123.6	1,368.8	.090
1995	144.6	1,494.7	.097
1996	168.3	1,632.2	.103
1997	194.3	1,782.4	.109
1998	222.8	1,946.3	.114
1999	254.0	2,125.4	.120
2000	287.9	2,320.9	.124
2001	324.9	2,534.5	.128
2002	365.2	2,767.6	.132
2003	409.2	3,022.3	.135
2004	457.0	3,300.3	.138
2005	509.0	3,603.9	.141
2006	565.8	3,935.5	.144
2007	627.5	4,297.6	.146
2008	694.8	4,692.6	.148
2009	768.1	5,124.7	.150
2010	848.0	5,596.1	.152
2011	935.0	6,111.0	.153
2012	1,029.8	6,673.2	.154
2013	1,133.2	7,287.1	.156
2014	1,245.8	7,957.6	.157
2015	1,368.7	8,689.7	.158
2016	1,502.6	9,489.1	.158
2017	1,648.6	10,362.1	.159
2018	1,808.0	11,315.4	.160
2019	1,981.7	12,356.4	.160
2020	2,171.3	13,493.2	.161
2021	2,378.0	14,734.6	.161
2022	2,603.7	16,090.2	.162
2023	2,849.9	17,570.5	.162
2024	3,118.3	19,187.0	.163
2025	3,411.7	20,952.2	.163
2026	3,731.7	22,879.8	.163
2027	4,080.9	24,984.7	.163
2028	4,462.1	27,283.3	.164

same. The comments of chapter 3 regarding the actual effective cost level apply here as well. Sixteen percent of current indemnity would constitute a lesser percentage of current benefit costs, and a still lesser percentage of workers' compensation insurance premium costs. These cost levels are also not including any interaction with other workers' compensation provisions, and do not allow for increased utilization.

There are vast unfunded liabilities inherent in this pay-as-you-go approach, of course. But this would not necessarily be grounds for dismissing the idea out of hand, especially if there is good reason to believe that the relationship between the revenue base and the cost burden is stable, and will remain so. In the benefit adjustment situation, this would involve the relationship between the indemnity paid in any particular year and the cumulative benefit adjustment costs for all previous injury cohorts as represented in table 20.

But table 20 simply demonstrated that *if* this relationship were constant, the assessment level would approach a stable value in the long-run. Thus it dealt only with the question of stability of assessment as the case population matured, not with variations in the underlying relationship between current indemnity payments and current benefit adjustment costs. To deal with this issue it is necessary to return to the benefit adjustment model.

Recalling the notation of the benefit adjustment model presented in chapter 2, the year j costs of a pay-as-you-go plan would be:

$$S_j = \sum_{i=1}^{j-w} f_{ij}C_{ij} = \sum_{i=1}^{j-w} f_{ij}(A_i p_{ij})\ (c_{ij}d_{ij})$$

In this model i represents the injury year, j the current year, w the waiting period before benefit adjustment begins, f_{ij} the specific adjustment factor for each injury cohort in year j, A_i the number of weekly benefit cases in injury year i, p_{ij} the proportion of the A_i cases still active in year j, c_{ij} the average weekly compensation rate in year j for cases from injury year i, and d_{ij} the average weeks duration in year j for cases from injury year i. The year j assessment base could be represented as:

$$B_j = A_j\ (c_j d_j) + \sum_{i=1}^{j-1} (A_i p_{ij})\ (c_{ij} d_{ij}) + R_j$$

where R_j represents the dollar amount of redemption payments in year j, and weekly compensation payments to year j injury cases have been removed from the summation.

But note that the middle term in this expression is nothing but the year j cost of active claims from earlier years, in other words, the cases which are eligible for benefit adjustment. In fact, if the waiting period for benefit adjustment was one year, this would represent perfectly the basic compensation payments in year j which are the object of benefit adjustment:

$$\sum_{i=1}^{j-1} C_{ij} = \sum_{i=1}^{j-1} (A_i p_{ij})\ (c_{ij} d_{ij})$$

When we multiply each cohort's compensation by its benefit adjustment factor, we obtain the year j costs of benefit adjustment:

$$S_j = \sum_{i=1}^{j-1} f_{ij} C_{ij}$$

But this means that this term appears in both the assessment base and the adjustment cost expressions. Since it is a component part of both quantities, variation in C_{ij} will not destabilize the relationship between them. It will in fact be a strong stabilizing influence, with the extent of this influence determined by the proportion of all indemnity payments in a given year which are paid to cases from previous injury years.

So the threat to cost stability for a pay-as-you-go operation lies in the relationship between the current year payments to new cases (including redemptions) and the continuing payments to old cases. Expansion in total first year workers' compensation indemnity payments from one injury cohort to the next will tend to reduce the cost burden of benefit adjustment slightly. Each new cohort would make a larger immediate impact on revenues than the new adjustment cohort will make on benefit adjustment costs.

But if first year indemnity were to decline, the twist would be reversed and the cost of pay-as-you-go benefit adjustment would rise relative to the assessment base. That would necessitate a higher assessment rate. This effect will be limited since, naturally, a less expensive cohort for assessment will soon translate into a less expensive cohort to adjust. But if workers' compensation costs were to reverse their historical escalation, it would make pay-as-you-go somewhat more expensive due to the differential impact on the assessment base and the benefit adjustment costs. This has the very unfavorable implication that if the incidence of disabling accidents could be reduced in the future, the rise in the relative cost of benefit adjustment for old cases would absorb some of the savings.

In chapter 3 we encountered another potential problem when it was pointed out that redemption settlements would contribute to the assessment base but not to any future cost burden on a benefit adjustment fund. It is clear that a changing incidence of redemptions would be destabilizing to a pay-as-you-go benefit adjustment fund. Fewer redemptions would clearly reduce the assessment base (B_i) directly; but if these claims enter weekly payment status instead, they would also increase the adjustment cost burden in future years. An increasing incidence of redemption settlements would of course reduce the relative cost of pay-as-you-go benefit adjustment through the same mechanisms. Thus redemptions would constitute a considerable potential destabilization threat to a pay-as-you-go benefit adjustment plan. It is not entirely clear whether the imposition of an inflation adjusted workers' compensation benefit would change the likelihood of a redemption settlement in a particular case. However, it is possible that it would. Thus the threat must be taken seriously.

Finally, the influence of the retention function must be considered. Since it is the model's determinant of the number of disability cases that will be adjusted in the future, it is again revealed to be the critical behavioral component. It is at the heart of the relationship between payments to new cases and payments to old cases. Clearly, a change in the average duration of disability cases would be seriously destabilizing to a current funded benefit adjustment operation, just as it would be to a prefunded plan. There is no particular reason why this should be more troublesome in a pay-as-you-go funding plan, however.

In fact, a current funded benefit adjustment plan could tolerate a higher level of uncertainty about the underlying case population parameters, since it would not be necessary to precisely delineate lifetime payments to one cohort in advance. Thus the fund could make maximum use of actual benefit adjustment experience as it unfolds. It is clear from table 20 that there would be plenty of time for adjustment to future expenditure levels as it becomes possible to forecast them with greater accuracy than is possible at the present time.

It would also be possible to structure a pay-as-you-go inflation adjustment program that would generate substantial reserves in the near term, but converge to a current funding approach at some later date. Suppose, for example, that a program was established with a 10 percent assessment rate against base year indemnity payments. Given the simulation

Table 21
Current Funded Operation - All Cohorts
10 Percent Assessment, 1979 - 2005

Year	Assessment Income (millions)	Adjustment Costs (millions)	Interest Earnings (millions)	Year-end Balance (millions)
1979	$ 33.5	$ 0	$ 1.2	$ 34.7
1980	36.6	.5	3.7	74.5
1981	39.9	2.0	6.5	118.9
1982	43.6	4.3	9.7	167.9
1983	47.6	7.4	13.2	221.3
1984	52.0	11.4	16.9	278.8
1985	56.8	16.4	20.9	340.1
1986	62.0	22.5	25.2	404.8
1987	67.7	29.8	29.7	472.4
1988	73.9	38.5	34.3	542.1
1989	80.7	48.5	39.1	613.4
1990	88.2	60.0	43.9	685.5
1991	96.3	73.1	48.8	757.5
1992	105.1	88.0	53.6	828.2
1993	114.8	104.7	58.3	896.6
1994	125.3	123.6	62.8	961.1
1995	136.9	144.6	67.0	1,020.4
1996	149.5	168.1	70.8	1,072.6
1997	163.2	194.3	74.0	1,115.5
1998	178.2	222.8	76.5	1,147.4
1999	194.6	254.0	78.2	1,166.2
2000	212.6	288.0	79.0	1,169.8
2001	232.1	325.0	78.6	1,155.5
2002	253.4	365.2	77.0	1,120.7
2003	276.8	409.2	73.8	1,062.1
2004	302.2	457.0	68.9	976.2
2005	330.0	509.1	62.1	859.2

results presented here, it would appear that this would be only about 40 percent of the required level for prefunding a 5 percent adjustment program. Yet table 21 shows that such an annual assessment level would be sufficient to cover annual adjustment costs for all cohorts (under the assumptions stated earlier) through 1994, or the first 16 years of operation of the fund. Further, substantial reserves would have been generated (approaching $1 billion), so that interest earnings would generate sufficient revenues to pay roughly half the annual adjustment costs at that time.

While this program would not be viable indefinitely under the assumptions supporting table 21 (the year-end balance begins to decline after year 2000), it would provide a reservoir of experience with which to set future assessment levels to provide for the continuance of the program in similar circumstances into the future. Since table 20 indicated that under the stated assumptions pay-as-you-go costs will eventually approach 16 percent of current indemnity, a gradual advance to that assessment level could be preprogrammed.

However, given the considerable uncertainties, it would seem preferable to choose an adaptive strategy that would allow accumulating experience to determine the assessment rates in the future. Legislation could provide for review of the status of the fund on a periodic basis and could also set targets or requirements for the level of reserves relative to annual expenditures. At any rate, the results of tables 20 and 21 help to show how much room for adaptability is available in this situation, provided adjustment is made well in advance of current requirements. If the administrators keep their gaze fixed 10 to 20 years in the future, adaptation to emerging inflation adjustment experience should be possible without wildly fluctuating assessment levels.

The problem is that this begins to sound like the "blank check" operation that employer interests resist so strongly.

However, there is no reason why a maximum assessment rate could not be written into the statute, together with provisions for dealing with any shortfalls that may develop subsequently. As discussed in chapter 3, a shortfall could be met either with the addition of public money or with some prorationing of benefits among existing beneficiaries.

Under such a current funding strategy, there is really not that much difference in practice from a prefunded benefit adjustment operation. It is in the nature of the contractual arrangements that a public fund will assign responsibility for some or all of the risk of a shortfall to employers, while private insurance carriers cannot. But it should not escape mention that the quid pro quo for this greater risk of future cost increases is lower present costs. Whether it is worth the trade must be debated in the legislative arena. Suffice it to say that a current funded benefit adjustment program for Michigan workers' compensation beneficiaries appears to be a viable alternative.

CHAPTER 6
Summary and Conclusions

We have examined in some detail the option of a state benefit adjustment fund to protect Michigan workers' compensation beneficiaries from the ravages of inflation. Such a fund would raise the required revenues through an assessment on total indemnity payments in each year. The proceeds would be invested by the fund administrators until needed to reimburse insurers for inflation supplements that would be added to weekly workers' compensation benefit checks. The underlying theme of this discussion has been uncertainty, and it is the subject of uncertainty that must dominate these conclusions as well.

A conceptual model was developed to help represent the factors that would determine the costs of benefit adjustment for the workers' compensation cases originating in one injury year (one injury cohort). The key behavioral component of this model was the retention function, a dynamic representation of the distribution of disability durations among workers' compensation cases. The retention function represented this distribution by the probability of retention (its complement is the probability of closure) of cases from one injury cohort through each of the 50 years following the injury year.

Due to the fact that unlimited duration disability benefits were only extended to general disability cases in Michigan in 1965, it is clear that 50 years of experience have not yet been accumulated. In fact, at the time of observation of the data base available for this study, only 13 years experience had accumulated. Thus the first level of uncertainty in the conclusions must be the uncertainty over the theoretical representation of the future duration experience for workers' compensation cases.

Beyond a dozen years, the retention function is based on hypothesis rather than demonstrated empirical facts. Thus there is uncertainty about how many cases will qualify for benefit adjustment payments in future years. While waiting for the accumulation of more data would help resolve the uncertainty, it would also delay the implementation of a program to protect claimants from inflation. We attempted to deal with this uncertainty in chapter 4 by substituting more pessimistic and optimistic hypothetical retention functions for the standard one presented in chapter 2. This analysis revealed substantial, though not ruinous, sensitivity to the specification of the retention function. Yet in the final analysis, the only advance test of the retention function is the test of reasonableness. It is submitted to the reader for this test.

There is a second level of uncertainty closely related in practical terms, though not in conceptual terms, to the first. The empirical base of the work presented here lies irrevocably in the *current* workers' compensation system. It is not possible to predict the behavioral response of claimants or insurers to the imposition of a benefit adjustment program. There are two major ways in which such responses could endanger the conclusions of this study. First, it is possible that the addition of inflation protection could alter the observed durations of disability. This might occur through a straight incentive effect (on either side) or, perhaps, through encouraging a more aggressive rehabilitation effort or some other indirect means.

Second, it has been pointed out that the incidence of redemption (compromise and release) settlements might be influenced by the addition of inflation protection to the income maintenance benefits in workers' compensation. The rationalist argument suggests that both parties to the compromise (the insurer and the claimant) should be able to estimate the present value of the expected future stream of benefits, whether adjusted for inflation or not. Thus while the dollar amount of the average redemption would likely change, there would be no reason to expect the proportion of cases redeemed to change as a result of the addition of inflation protection. However, it is also possible that the decisions to compromise are not made on a rational expectations basis, and thus the possibility of reaction is very real.

It was demonstrated earlier that an increasing incidence of redemptions relative to weekly benefit cases would result in a financial advantage for a benefit adjustment fund. This is true because the dollars paid in redemptions enter the assessment base, but do not give rise to an associated long term claim for benefit adjustment. On the other hand, if the addition of inflation protection makes claimants significantly less likely to accept redemption settlements, this will raise the benefit adjustment cost burden while at the same time reducing the injury year assessment base. In chapter 5 this was cited as a significant destabilizing threat for a current funded strategy, but the same problem exists in a prefunded approach.

The last level of uncertainty to be dealt with is the uncertainty over the future developments that will condition both the costs and the revenues of a benefit adjustment fund. We cannot know in advance what inflation rates will be for the next five years, much less the next 50 years. Thus we cannot estimate accurately the annual adjustment factors or interest earnings rates that will be encountered. But with a forward funding approach, it is necessary to raise sufficient revenues this year to guarantee inflation protection for the lifetime of the youngest claimant in this year's injury cohort.

In chapter 4 this uncertainty problem was attacked with a range of assumed values for these critical parameters. We examined average annual inflation adjustment factors from 4 to 8 percent, and interest earnings rates on fund balances from 6 to 10 percent, in an attempt to bracket the actual values that could be expected. It was also shown in chapter 4 that it is the relationship between these two future parameters as well as their absolute values that will influence the performance of the benefit adjustment fund. This is clear from the fact that paying higher adjustment factors hurts, but earning higher interest rates helps the fund. Since these two inflation parameters tend to move together, the potential impact of each is somewhat mitigated. Nevertheless, a substantial level of uncertainty remains about the way in which future states of the world will impact a benefit adjustment fund for workers' compensation beneficiaries.

All three of these types of uncertainty (uncertainty over whether we have represented the current workers' compensation experience adequately, uncertainty over whether the current workers' compensation experience will be an adequate guide in the future, and uncertainty over future states of the world within which the workers' compensation system will operate) lead to the same conclusion, fears about the sufficiency of the assessment level for a forward funded inflation protection program.

These fears cannot be allayed at a reasonable cost level. In the sensitivity analysis it was shown that under favorable assumptions about future inflation rates, a lifetime benefit adjustment program for the 1978 injury cohort could be provided for about $60 million. With unfavorable assumptions (i.e., higher inflation rates), the same program would cost over $125 million. But there is no guarantee that even $125 million will be sufficient. It clearly is more likely to suffice than a lesser number, but there is still a significant chance of shortfall.

It was concluded in chapter 4 that a benefit adjustment program for one Michigan injury cohort could be adequately prefunded with an assessment of 30 to 33 percent of base year (injury year) indemnity payments. As pointed out at that time, this would amount to an annual benefit cost increase of 22 to 25 percent, although the insured sector's share would only constitute about an 8 percent addition to the workers' compensation insurance bill.

But this conclusion from the simulation analyses really amounts to a judgment about the various factors producing the levels of uncertainty discussed previously. Concluding that a 30 percent assessment will be sufficient is a result of: (1) accepting 6 to 7 percent as a reasonable estimate of average inflation rates over the next 50 years; (2) judging 2 percent to be an adequate estimate of future real interest rates; (3) accepting the standard retention function as sufficiently conservative that it does allow for some increases in utilization as a result of the introduction of benefit adjustment; (4) assuming that the proportion of redemptions will not change materially; and (5) ignoring potential complications like the savings in current differential benefit payments, possible savings from benefit coordination, changes in the definition of disability, or other statutory changes that might be introduced.[1]

A 33 percent assessment rate clearly would allow more margin for error; roughly 1 percent more in the average annual inflation rate, or half a percent less in the real interest rate, or a greater increase in utilization, etc. If all future developments were negative, the 33 percent assessment

1. See the section called "Evaluation of Estimate" in chapter 3 for the discussion of these factors.

would apparently not be sufficient to make lifetime inflation adjustment payments unless some corrective action were taken, such as capping the annual or lifetime adjustment factors, disqualifying some claimants, etc.

Finally, all of this assumes that the current Michigan workers' compensation system is adequately represented in the model developed here, specifically that the case duration experience is accurately summarized by the retention function presented earlier. In the face of such overwhelming uncertainty, one is reduced to carefully examining the set of assumptions underlying a given cost estimate and reacting to the reasonableness of those assumptions. But it is important to recognize that if the future takes a radically different course, those same assumptions may not look very reasonable in hindsight.

For this reason, it is imperative that a benefit adjustment program include arrangements for detecting and adjusting to shortfalls or, more happily, to surpluses in the assessment levels. In other words, there must be a plan for adapting the fund to the actual benefit adjustment experience as it unfolds. As mentioned in chapter 3, an adequate data system will be vital to tracking the benefit adjustment costs for each injury cohort in future years. This will make it possible to detect an impending shortfall or surplus while there is still time to adjust.

Assuming strict segregation of funds for different cohorts is maintained, adjustment to errors in assessment levels would be difficult but not impossible. If a supplemental assessment strategy were followed, it would be necessary to deal with the effect of mergers, bankruptcies, and other evolutionary changes in the employer population. The problems would certainly be much more tractable than those associated with retrospective inflation adjustment since records would be available from each assessment year and it would be much easier to reconstruct the assessment base. Presumably, the contractual problems between carriers and employers inherent in retrospective adjustment would also not arise since the benefit adjustment obligation would be imposed on the employer directly through the assessment. The carriers would only act as delivery agents for the inflation supplements.

How easy it will be to actually levy a supplementary assessment (retroactive assessment, in essence) remains to be seen. Clearly, there is considerable resistance to "reopening the books" on an old injury cohort, although in the case of refunding a surplus this would probably cause no difficulty. It was also pointed out earlier that it would be possible to make the adjustment to a shortfall through the injection of public funds if that is deemed preferable.

But considering the extended time horizons dictated by the obligation of lifetime inflation protection payments, and the very large reserves that would result from current funding of those obligations, perhaps the adjustment potential offered by implicit inter-cohort borrowing would be the preferred strategy for dealing with the uncertainties inherent in the benefit adjustment problem.

In chapter 3 it was suggested that the assessment rate be set at the level judged adequate to prefund lifetime benefit adjustment payments to one cohort. Then, as time progresses and future uncertainties become past realities, a periodic review of the sufficiency of each cohort's assessment would be conducted. In the event that either surpluses or shortfalls predominate, future assessment rates could be adjusted accordingly. Thus while assessments from different years would be commingled, the determination of the adequacy of fund reserves would derive from separate projections of benefit adjustment costs for each cohort. This individual cohort measurement is important because the simulation of a full fund operation in chapter 3 shows that fund balances can be expected to grow indefinitely with a prefunding strategy. Therefore, total fund balances cannot provide an accurate guide to the financial health of a forward funded benefit adjustment plan.

It is likely that this breach of the pure forward funding principle will cause some to oppose it on principle. It will cause others to rush to the opposite extreme of a pay-as-you-go benefit adjustment plan. For that reason, a pay-as-you-go strategy was also simulated in chapter 5. Under the standard assumptions of this study, it was determined that a current funded benefit adjustment plan would gradually rise in cost to just over 16 percent of annual indemnity costs as the case population receiving inflation adjustment payments matured over the 50-year simulation period.

The danger in a pay-as-you-go funding strategy derives largely from the imperfect linkage between the cost burden and the revenue base, so an examination of the components of the annual assessment base was carried out using the simple benefit adjustment model developed here. It was discovered that there were grounds for concern, particularly as regards the proportion of redemptions in the Michigan workers' compensation system. If this proportion were to change substantially, it would have very considerable destabilization potential for a pay-as-you-go benefit adjustment plan.

Thus it would seem prudent to consider at most a modified pay-as-you-go plan. This would involve setting an assessment rate somewhere between that required to raise the annual adjustment costs for all cohorts and the fully prefunded level discussed earlier. For the sake of illustration, an assessment rate of 10 percent was considered in chapter 5. Under the standard assumptions of this study, such an assessment rate (about 40 percent of the full prefunded level) would provide a viable benefit adjustment fund for some 15 or 20 years. That is to say, the annual payout does not overtake the annual assessment income until 16 years into the simulation. The year-end balance would grow for over 20 years under the assumptions used here about the benefit adjustment fund parameters.

Such a compromise strategy would allow the accumulation of a data base sufficient to narrow the range of uncertainty significantly from current levels, thereby making possible a more adequate determination of the costs of benefit adjustment. It would of course accomplish this at the cost of the unfunded liabilities that will have been accrued in the intervening years. Nevertheless, the conclusion was reached that this adaptive pay-as-you-go approach would be a viable option, provided the fund administrators kept their attention riveted 10 to 20 years in the future and did not overreact to immediate circumstances.

The following has been stated repeatedly throughout this paper, but it needs repetition one last time. This study does not provide a blueprint sufficient for construction of a benefit adjustment program. It is an attempt to provide a guide to some of the issues that must be settled, some of the hard choices that must be made, before such a program can be instituted. It is also an attempt to cope with the very great uncertainties that plague the exercise of looking into the future.

While the focus of the discussion has been largely on the problems of implementing a benefit adjustment program, this should not be taken as disapproval of the concept. If the uncertainties of inflation adjustment are very great, so is the need. To repeat the conclusion of the introductory chapter; the success of this effort will not be measured by the adoption of a state benefit adjustment fund. Rather, it will lie in provoking the serious consideration of this and other options available to attack the problem of inflation protection for the long term disabled.

APPENDIX A
Projected Costs of Retrospective Inflation Adjustment

In order to estimate the future costs of retrospective inflation protection proposals it is necessary to predict the number of cases from each injury cohort that will be active and eligible for adjustment at each year in the future. The data to make this kind of prediction possible are contained in the tabulation of active cases by injury year at the end of 1977 and 1978, which were provided by the Bureau of Workers' Disability Compensation. These data are reported in table A-1, together with the year-to-year net retention rates that are implied by the differences between the two years' observations. The basic source of these data is the Form 103 "Annual Report on Payment of Compensation" that must be filed with the Bureau for every case being compensated as of December 31. This should be an accurate measurement, but there may in fact be as much as a 15 percent under-reporting of active cases. Since it is not known in what way this would bias the age distribution of the cases, it was not thought advisable to simply mark up each active cohort by 15 percent. Adjustment for this factor will be made later.

From table A-1 it appears that the retention rates for active cases are subject to a declining step function through time. Thus, among the 1977 injury cases active at the end of 1977, about 40 percent are still active at the end of 1978. This is a net figure since it also includes cases active at the end of 1978 that were not active one year earlier. In the absence of other information, we have assumed that among the cases from the current injury year that are still active at the end of the year, 60 percent will be closed during the following year.

We can proceed similarly step by step to describe the persistence of workers' compensation cases through time using the two observation points reported in table A-1.

Table A-1
Active Case Population, 1977 and 1978, by Injury Year

Injury Year	Cases Active 12/31/77	Cases Active 12/31/78	Implicit Retention Rate
1978	--	7,624	--
1977	6,953	2,805	.403
1976	2,452	2,077	.847
1975	1,979	1,696	.857
1974	1,970	1,830	.929
1973	1,609	1,447	.899
1972	1,380	1,315	.953
1971	1,224	1,182	.966
1970	1,062	1,068	1.006
1969	926	837	.904
1968	678	669	.987
1967	569	550	.967
1966	546	542	.993
1965	204	200	.980

SOURCE: Bureau of Workers' Disability Compensation.

On the basis of the figures in table A-1, it is estimated that 40 percent of the cases active at the end of the injury year are still active at the end of the next calendar year. Roughly 85 percent of these remaining cases are still active at the end of the second full year following the injury year. Similarly for the third year, 85 percent remain active and 15 percent are closed for one reason or another. It also appears from table A-1 that roughly 92 percent of the remaining cases are retained in each of the next two years, the fourth and fifth full years following the injury year. Thereafter, about 96 percent are retained from year to year; 4 percent are closed annually.

After 20 years, it is hypothesized that the retention rate declines again to 92 percent as old age overtakes a larger and larger proportion of the injured workers.

This retention function can be applied to each injury cohort to estimate the number of workers' compensation cases that will be active at the start of each year subsequent to the injury year. This procedure can be applied to future cohorts as well after the size of the group is predicted through other means. For this exercise, the underlying workers' compensation weekly payment case population was projected to grow at a 10 percent compound annual rate. Table A-2 presents the projected active case population from each injury year cohort for each year up to 1983. This is the estimated case population which could be eligible for inflation adjustment payments, depending on the specific parameters of the plan. It should be recalled that these estimates are subject to the possible under-reporting bias mentioned earlier, since all projections proceed from that data base.

It is also necessary to project the average weekly compensation rate that will be paid to future injury cohorts so that the cost of a particular plan can be estimated. These estimates are also presented in table A-2. They were derived by projecting a 10 percent increase from 1978 to 1979 and a 12 percent increase from 1979 to 1980. With the estimated number of cases to be adjusted from each injury cohort in each future year and an average compensation rate for each cohort, we need only apply the specific benefit adjustment plan to this data base to obtain the estimated cost of the plan in each future year.

Tables A-3, A-4, and A-5 show the unadjusted cost estimates for the Governor's plan (appendix B) as submitted to the Workers' Compensation Reform Task Force. The unadjusted cost of this retrospective plan is projected at

Table A-2
Cases Active by Injury Year, 1978-1983

Injury Year	Cases Active						Average Weekly Compensation Rate
	1/1/78	1/1/79	1/1/80*	1/1/81*	1/1/82*	1/1/83*	
1980	--	--	--	9,119	3,648	3,101	$170.98*
1979	--	--	8,290	3,316	2,819	2,396	152.66*
1978	--	7,624	3,050	2,592	2,203	2,027	138.78
1977	6,953	2,805	2,384	2,027	1,864	1,715	125.95
1976	2,452	2,077	1,765	1,624	1,494	1,435	113.58
1975	1,979	1,696	1,560	1,435	1,378	1,323	105.66
1974	1,970	1,830	1,684	1,616	1,552	1,490	100.66
1973	1,609	1,447	1,389	1,334	1,280	1,229	95.82
1972	1,380	1,315	1,262	1,212	1,163	1,117	86.52
1971	1,224	1,182	1,135	1,089	1,046	1,004	89.77
1970	1,062	1,068	1,025	984	945	907	77.72
1969	926	837	804	771	741	711	73.31
1968	678	669	642	617	592	568	67.30
1967	569	550	528	507	487	467	67.94
1966	546	542	520	500	480	460	65.27
1965	204	200	192	184	177	170	60.50

*Projected.

Table A-3
Retrospective Inflation Adjustment, Projected Cost in 1981

Injury Year	Number of Cases*	Average Compensation Rate	Total Weekly Compensation	Inflation Adjustment Factor	Average Weekly Supplement	Total Weekly Supplement
1978	2,592	$138.78	$ 359,718	.100	$13.88	$ 35,972
1977	2,027	125.95	255,301	.150	18.89	38,295
1976	1,624	113.58	184,454	.200	22.72	36,891
1975	1,435	105.66	151,622	.250	26.42	37,906
1974	1,616	100.66	162,667	.296	29.80	48,149
1973	1,334	95.82	127,824	.346	33.15	44,227
1972	1,212	86.52	104,862	.396	34.26	41,525
1971	1,089	89.77	97,760	.446	40.04	43,601
1970	984	77.72	76,476	.484	37.62	37,015
1969	771	73.31	56,522	.534	39.15	30,183
1968	617	67.30	41,524	.584	39.30	24,250
1967	507	67.94	34,446	.584	39.68	20,116
1966	500	65.27	32,635	.584	38.12	19,059
1965	184	60.50	11,132	.584	35.33	6,501
	16,492	$102.89	$1,696,943		$28.12	$463,690
						x 52
				Unadjusted annual cost		$24,111,880

*Projected to January 1, 1981.

Table A-4
Retrospective Inflation Adjustment, Projected Cost in 1982

Injury Year	Number of Cases*	Average Compensation Rate	Total Weekly Compensation	Inflation Adjustment Factor	Average Weekly Supplement	Total Weekly Supplement
1979	2,819	$152.66*	$ 430,349	.100	$15.27	$ 43,035
1978	2,203	138.78	305,732	.100	13.88	30,573
1977	1,864	125.95	234,771	.150	18.89	35,216
1976	1,494	113.58	169,689	.200	22.72	33,938
1975	1,378	105.66	145,599	.250	26.42	36,400
1974	1,552	100.66	156,224	.296	29.80	46,242
1973	1,280	95.82	122,650	.346	33.15	42,437
1972	1,163	86.52	100,623	.396	34.26	39,847
1971	1,046	89.77	93,899	.446	40.04	41,879
1970	945	77.72	73,445	.484	37.62	35,548
1969	741	73.31	54,323	.534	39.15	29,008
1968	592	67.30	39,842	.584	39.30	23,267
1967	487	67.94	33,087	.584	39.68	19,323
1966	480	65.27	31,330	.584	38.12	18,296
1965	177	60.50	10,708	.584	35.33	6,254
	18,221	$109.89	$2,002,271		$26.41	$481,263
						x 52
					Unadjusted annual cost	$25,025,676

*Projected to January 1, 1982.

Table A-5
Retrospective Inflation Adjustment, Projected Cost in 1983

Injury Year	Number of Cases*	Average Compensation Rate	Total Weekly Compensation	Inflation Adjustment Factor	Average Weekly Supplement	Total Weekly Supplement
1980	3,101	$170.98*	$ 530,209	.100	$17.10	$ 53,021
1979	2,396	152.66*	365,773	.100	15.27	36,577
1978	2,027	138.78	281,307	.100	13.88	28,131
1977	1,715	125.95	216,004	.150	18.89	32,401
1976	1,435	113.58	162,987	.200	22.72	32,597
1975	1,323	105.66	139,788	.250	26.42	34,947
1974	1,490	100.66	149,983	.296	29.80	44,395
1973	1,229	95.82	117,763	.346	33.15	40,746
1972	1,117	86.52	96,643	.396	34.26	38,271
1971	1,004	89.77	90,129	.446	40.04	40,198
1970	907	77.72	70,492	.484	37.62	34,118
1969	711	73.31	52,123	.534	39.15	27,834
1968	568	67.30	38,226	.584	39.30	22,324
1967	467	67.94	31,728	.584	39.68	18,529
1966	460	65.27	30,024	.584	38.12	17,534
1965	170	60.50	10,285	.584	35.33	6,006
	20,120	$118.46	$2,383,464		$25.23	$507,629
						x 52
				Unadjusted annual cost		$26,396,708

*Projected to January 1, 1983.

$24.1 million for calendar 1981. For 1982, the cost is expected to rise to $25.0 million. The increase is so small because the incoming 1979 cohort to be adjusted is partly offset by predicted closures of cases from other cohorts. Table A-5 shows the 1983 unadjusted costs to be $26.4 million. Note that it is projected that in 1983 there will be nearly 20,000 cases to be adjusted; the incoming cohorts are larger than the annual closures so the active case population will continue to rise.

These unadjusted estimates must be qualified by some major cost adjustments. The first is the possible underreporting of active cases that was mentioned earlier. If up to 15 percent of active cases are not reported, they are missing from the data base and hence are not included in the cost estimates. It would seem likely that there would be a bias toward newer cases among those that go unreported since the routine of filing Form 103 may not have yet been established. But assume the unreported cases are distributed across injury years exactly as the reported cases are. Then we will have underestimated the potential cost of inflation adjustment by 15 percent.

On the other hand, some portion of the inflation adjustment burden is already being handled. The Second Injury Fund pays inflation supplements (called differential benefits) to those individuals who are permanently and totally disabled as defined in Michigan statute. This is to ensure that these claimants get the same benefits they would be entitled to if they suffered their injury today.[1] Generally, the differential benefit would be greater than the benefit adjustment directed by the Governor's proposal and thus no additional retrospective payment would be required. (See Section 352(6) of the Governor's proposal.) This is particularly clear for cases dating from before 1965 since any cases still active

1. See Section 521(2) of the Michigan Workers' Disability Compensation Act.

from injury years before 1965 must be permanent and total disabilities inasmuch as other types of cases were not granted lifetime benefits until September 1, 1965. Thus, if a 1964 case is still being paid, it must be a permanent total disability; otherwise the maximum term of 800 weeks of benefits which applied at that time would have already elapsed. In consequence, it is not necessary for the inflation adjustment plan under consideration to adjust these cases and they were simply excluded from all calculations as they were from the Governor's proposal (See Section 352(1)).

But in addition to this group of cases, there will be the more recent permanent and total disabilities which may qualify for partial adjustment under Section 352(6). While it is impossible to accurately measure the savings in costs due to overlap of adjustment cases without a full survey of the current differential benefit population, indicative results are available from earlier cost estimations. When we compared the cost of adjusting known active cases on January 1, 1979 with the cost of adjusting that population *less* the number of cases receiving differential benefits, it was discovered that a reduction of 7.6 percent was realized. This is therefore taken to represent the magnitude of the potential savings to a general retrospective inflation adjustment plan due to Second Injury Fund differential benefit payments.

The last adjustment to be added derives from the exclusion of fatalities and partial disability cases from eligibility for inflation adjustment in the Governor's proposal (See Section 352(11)). There is no reliable source of data with which to estimate the cost savings that this provision would produce. However, sources familiar with the Michigan workers' compensation system have estimated that between 5 and 10 percent of active cases are partial disability or fatalities, with the bulk of this being fatalities. If these cases were excluded from eligibility, it could be anticipated that a savings of somewhat less than the number of cases would be realized.

This would reflect the lower average compensation rate for partials and the lower average age of fatality cases due to the 500-week benefit limitation.

Summing all three adjustments is a challenge. While they are all real, their exact magnitudes are unknown; they probably will never be known with reasonable certainty. Given this level of uncertainty, it is probably unwise to proceed to sum the adjustment factors and apply the results to tables A-3 through A-5. It would be unrealistic to pretend that sort of precision was available. Accordingly, we will just point out that these three factors will *tend* to be offsetting. If we have underestimated the basic costs of the plan by 10 to 15 percent due to unreported cases, we have overestimated the costs by 10 to 15 percent due to the overlap with differential benefits and the inclusion of fatality and partial disability cases in our estimates. We will therefore let the unadjusted figures of tables A-3, A-4, and A-5 stand as the current best cost estimates pending additional data or experience.

By way of conclusion, it is only necessary to remind ourselves of the very great uncertainties inherent in these projections. We do not have sufficient information to proceed with confidence even in assessing known biases. Behind these lie all the interactions with other potential elements of a reform package such as offsets for pensions and Social Security benefits, changes in the definition of disability that would alter the differential benefit situation, and many others. Given all this, these estimates should be taken as indicative of a general range of cost impact only, they do not constitute a blueprint for the future.

APPENDIX B
Governor's Proposal

Sec. 352. (1) Compensation rates otherwise payable under Section 351 shall be adjusted one time for any employee receiving or entitled to receive benefits whose date of injury is from September 1, 1965, through December 31, 1980. The percentage adjustment shall be computed using the total percentage changes (increase or decrease) in the average weekly wage in covered employment as used in Section 355, rounded to the nearest one-tenth of one percent. The adjustment shall not exceed 5% of the original compensation rate for each calendar year included in the adjustment period. The adjustment period shall be a period of not less than two consecutive calendar years following the base year as outlined below, the adjustment to be effective on the January 1 following the adjustment period. The percentage change shall be computed from the base year to the last year in the adjustment period. For injuries occurring from September 1, 1965, through December 31, 1968, the base year shall be 1968, and thereafter the base year will be the year in which the injury occurred. On January 1, 1981, rates will be adjusted as shown in Subsection (2) for any employee whose date of injury is from September 1, 1965, through December 31, 1978. On January 1, 1982, rates shall be adjusted for any employee whose date of injury is from January 1, 1979, through December 31, 1979. On January 1, 1983, rates shall be adjusted for any employee whose date of injury is from January 1, 1980, through December 31, 1980.

(2) On January 1, 1981, a previously injured employee's compensation rate shall be increased by the percentage shown, subject to the limitation in Subsection (7), for injury dates in the following periods. For the period from

September 1, 1965, through December 31, 1968, rates shall be increased by 58.4%; for calendar year 1969 rates shall be increased by 53.4%; for calendar year 1970 rates shall be increased by 48.4%; for calendar year 1971 rates shall be increased by 44.6%; for calendar year 1972 rates shall be increased by 39.6%; for calendar year 1973 rates shall be increased by 34.6%; for calendar year 1974 rates shall be increased by 29.6%; for calendar year 1975 rates shall be increased by 25.0%; for calendar year 1976 rates shall be increased by 20.0%; for calendar year 1977 rates shall increase by 15.0%; and for calendar year 1978 rates shall be increased by 10.0%.

(3) On December 1, 1981, the director shall announce the adjustment to be effective on January 1, 1982, for employees whose date of injury occurred in calendar year 1979 using the formula in Subsection (1). On December 1, 1982, the director shall announce the adjustment to be effective on January 1, 1983, for employees whose date of injury occurred in calendar year 1980.

(4) The legislature may, after the third anniversary of this section and every third year thereafter, consider an additional adjustment of benefit levels for all injured or disabled employees receiving or entitled to receive benefits at that time.

(5) All claims found compensable subsequent to the adoption of this section with an injury date preceding the effective date of this section shall be paid at the rate computed in accordance with this section.

(6) An employee eligible to receive differential benefits from the Second Injury Fund under Section 521 shall be paid the adjustment provided in this section as reduced by the amount of the differential payments being made to him or her by the Second Injury Fund at the time of adjustment.

(7) The adjusted weekly compensation computed pursuant to this section shall not exceed the maximum weekly rate of compensation provided in Section 355 in effect on the date of adjustment.

(8) An employee shall not be entitled to benefits under this section for an injury for which liability has been redeemed.

(9) The adjustments provided in this section shall be paid by the carrier on a weekly basis. However, the carrier, the Second Injury Fund and the Self-insurers' Security Fund shall be entitled to reimbursement for these payments from the compensation adjustment fund created in Section 391.

(10) This section shall not become effective until the annual appropriation required in Section 391 has in fact been appropriated by the legislature in sufficient amounts to meet the obligations of the fund created in Section 391, and if in any subsequent year funds are not appropriated by the legislature, benefits required by this section shall not be paid by carriers, the Second Injury Fund or the Self-insurers' Security Fund until such appropriation has in fact been made.

(11) This section shall not apply to anyone receiving weekly benefits under Sections 361(1) or 321.

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